MEGARON

ARTICLE

MEGARON 2021;16(4):659-670

DOI: 10.14744/MEGARON.2021.42713

A Research on Learning Styles - An Introduction to Architectural Design Studio

Mimari Tasarıma Giriş Stüdyosunda Öğrenme Stilleri Üzerine Bir Araştırma

Fatma KOLSAL, Ozlem KANDEMİR

ABSTRACT

This research was executed with the purpose to discover if there is a correlation between the learning styles and spatial abilities of novice students of architectural education and their success in a given design exercise. In the research, a group of 17 first-year students of architectural education was assigned with a multiphase design problem. The design process was realised, improved, and finalised within 5 weeks through studio discussions and critics. After the exercises were completed, the students are asked to participate in David Kolb's learning style inventory and a spatial-visual perception test. The results of the inventory and the test were compared with and correlated to the students' performance in the design studio for the given problem. According to the results of Kolb's learning style inventory, among 17 attendants, it is seen that 76.4% of the students are "convergent" 17.6% is "assimilator", 6% is "accommodator". Interestingly there is no student with a "divergence" type of learning. Regarding the studio exercise, it is discovered that the grades of the 17 students differ. According to this comparison, it is observed that the students with the learning style of "assimilation" had the highest grades in the design process. In other words, the students with assimilating learning styles are accepted as more promising for this design exercise compared to the other students with other learning styles. It is found critical to further these kinds of studies through which the designedly educative strategies may adopt new methods to promote the production of creative knowledge.

Keywords: *Creativity; design education; Kolb's learning styles; personal knowledge.*

ÖZ

Bu çalışma, öğrenme stilleri ve mekânsal algı düzeyinin, mimari tasarlamadaki başarı ile aralarında bir ilişki olup olmadığını tespit etmek amacıyla gerçekleştirilmiştir. Mimarlık eğitiminde 17 ilk yıl mimarlık öğrencisinin katılımıyla, tasarım stüdyosu egzersizi olarak çok aşamalı ve beş hafta süren bir tasarım problemi tanımlanmıştır. Bu problemde bir meyvenin kesit bilgisinden, iki ve üç boyutlu olmak üzere, yapısal ve mekânsal bilgiler üretilmesi beklenmiştir. En son aşamada ise tüm analitik bilgiler ilişkilendirilerek tek kişilik mekânsal bir barınma kabuğu tasarlanması istenmiştir. Tüm süreç öğrencilerle önceden paylaşılmış olan tasarım ve değerlendirme kriterleri çerçevesinde incelenmiştir. Stüdyodaki tasarım çalışmasının tamamlanmasının ardından, tasarım üreten öğrencilere David Kolb'un öğrenme stilleri envanteri ve mekânsal algı testi yazılı olarak yüz yüze uygulanmıştır. Test sonunda elde edilen veriler, bilgisayar ortamına aktarılmış ve dijitalleştirilmiştir. Bu süreçte, Kolb'un öğrenme stili envanterinin sayısal değerlendirme aşamaları uygulanmıştır. Mekânsal algı testinde ise çoktan seçmeli ve çizerek tarifleme aşamaları karma olarak kullanılmış ve öğrencilerin tamamı bu teste doğru cevaplar verdiğinden, testin sonucu bu araştırmada etki eden bir veri olarak ele alınmamıştır. Kolb testinde ise öğrencilerin, ayrıştıran, değiştiren, yerleştiren ve özümseyen öğrenme tiplerinden hangisinde olduğu belirlenmeye çalışılmıştır. Sonuçlarına göre, 17 katılımcı öğrenciden, %76.4'ünün "değiştiren", %17.6'sının "özümseyen", %6'sının ise "yerleştiren" olduğu görülmüştür. "Ayrıştıran" öğrenme stilinde bir öğrenci tespit edilmemiştir. Bu çeşitliliğe göre tasarım sürecinde en yüksek notları "özümseyen" öğrenme stiline sahip öğrencilerin aldığı ortaya çıkmıştır. Özümseyen öğrenme stillerine sahip öğrenciler, farklı öğrenme stillerine sahip diğer öğrencilere kıyasla bu tasarım çalışması için daha olumlu sonuçlar elde etmiştir. Sonuç olarak, tasarım eğitim stratejileri geliştirilirken bu tür araştırmaların önemli katkısı olabileceği görülmüştür.

Anahtar sözcükler: *Yaratıcılık; tasarım eğitimi; Kolb'un öğrenme stilleri; kişisel bilgi.*

Department of Architecture, Eskişehir Technical University Faculty of Architecture and Design, Eskişehir, Turkey

Article arrival date: **December 07, 2020** - **Accepted for publication:** **September 12, 2021**

Correspondence: Fatma KOLSAL. **e-mail:** fatmakolsal@eskisehir.edu.tr

Introduction

Social changes specific to the age of information and communication force the way of life and thus educational systems is set to change. Conventional education models, which depend on formal methods, may be insufficient in terms of current requirements; thus, the creation of new educational paradigms is inevitable. The new paradigm, which is widespread in education, is based not only on the transmission of knowledge but also on the production of it. There is a shift from conductive preferences towards constructive ones. This changing climate in the nature of thinking affects all educative strategies as well as education-related to design and creativity. The production, transformation, transmission, and application of design knowledge and therefore the management of the design process can be considered as the basic problems of design education. In this context, discussing new models and approaches, methods, and behaviours related to design learning/teaching has gained more importance.

For this reason, every layer of design has become a significant subject matter of research as an independent field of study. In addition to this increasing interest, the design product being per se a type of knowledge now gains much more attention than before under the circumstances of the 21st century.

The competencies and emerging roles of the people in the 21st century, which is defined as a knowledge society, are highly engaged with the designerly issues, which have already been discussed since the 1980s in creative fields, especially in architectural education. Nigel Cross (1982), Donald Schön (1985), Ashraf M. Salama (1995), and Bryan R. Lawson (2006), in their studies, turned the attention to the immense world of design, its pedagogy, education, and the undiscovered potential of the design knowledge. The design and creation are interconnected processes of the man's mind and there are "designerly" ways of knowing that are embodied in the process of designing. However, there is an equally important area of knowledge embedded in the products of designing, too (Cross, 1982).

In the age of information, there is plenty of data, which we are all exposed to. The visual data has great to do with design issues in this exposure. Here, the new meaning and contents of the concepts of design and creativity, which are changing according to the era, should be discussed paying attention to the new attitudes in design education to find an original path in designing creatively and authentically. The perception of creativity moving from a problem-solving concept to a concept of re-interpretation of the accumulated knowledge could be accepted as a beginning point.

Creativity is one of the most noteworthy competencies, which has divergent contextual and personal parameters to be evaluated. According to many scholars "creativity" is a vast concept and it is difficult to make a common definition (Amabile, 1996; Csikszentmihalyi, 1997; Kaufman & Baer, 2005; Pope, 2005). Among many others, Rob Pope's definition may be adaptive for contemporary circumstances. According to him, creativity is:

'…the application of knowledge and skills in new ways to achieve a valued goal…' (Pope, 2005, p.27).

Within the context of creativity, when the previous works are examined, it is seen that there are some studies executed in Turkey as well. Elvan Elif Özdemir (2013) states that creative thinking is: seeing problems and gaps in knowledge, developing ideas and hypotheses, producing original ideas, seeing the relationship between ideas, and obtaining new combinations by improving thought parameters. For this reason, Özdemir emphasises the creative thinking process as an approach to design and foresight. This design and foresight symbolise a free gaze beyond any kind of conditioning, breaking out of stereotypes, and a search from the known to the unknown (2013).

Özgen Osman Demirbaş's research, which is related to creative thinking-oriented studies in the field of architecture and design, the relationship between the learning preferences of the first-year interior architecture students and their design performances in different design exercises was investigated. The learning styles were determined by David Kolb's Experimental Learning Theory, and the results were examined and compared with the design findings. It has been seen that while students with a certain learning style have an advantage in different design exercises, this learning style is also a disadvantage for them in a different design exercise (2001).

Alternatively, Kvan and Yunyan (2005) investigated the effects of different learning styles behaviours on design performance in the second- and third-year architecture students. Tezel and Casakin (2010), on the other hand, looked at the relationship between the academic performance of individuals and their learning styles in two separate design conditions with Interior Architecture students. It has been observed that the different design product evaluation criteria determined are related to the learning styles.

From a different perspective, Özdemir's research (2013) determined the learning styles of the first-year architecture undergraduate students by using the learning style inventory based on Kolb's Experimental Learning Theory and examined their effects on the design process and design product. The design process behaviours of the same students were also followed in the second year of their education. The research emphasises that learning styles are important for both design students and design

studio-instructor in environments such as architectural education, where it is aimed to gain the ability and skills to make 'Individual Designs.' When the individual learning styles of individuals under different design conditions are known, their strengths and weaknesses will also be identified, so a method can be applied to improve their behaviour in certain design problems. Özdemir states that knowing the learning styles of the students will allow the design studio instructor to easily determine which role the student will assume in the design studio, and to guide the student accordingly by letting the design studio instructor know the behaviour of the student during the design process.

At this point, explaining how Kolb's inventory works may be enlightening. Kolb's inventory is based on experiential learning theory and is designed to help individuals identify the way they learn from experience (A. Y. Kolb, 2005). Supporting the idea of Michael Polanyi (1958) about personal knowledge and John Dewey (1986) emphasising the need for a sound philosophy of experience, Kolb developed a new look at experiential learning. According to him, all learning is re-learning. A process that draws out the learners' beliefs best facilitates learning and ideas about a topic so that they can be examined, tested, and integrated with new, more refined ideas. Experiential learning is a powerful and proven approach to teaching and learning that is based on one incontrovertible reality: people learn best through experience. (D. A. Kolb, 2014).

Therefore, the inventory reveals the cognition and perception of the attendant with respect to the ways of learning. The purpose of it is to serve as an educational tool to increase individuals' understanding of the process of learning from experience and their unique individual approach to learning. By increasing awareness of how they learn, the aim is to increase learners' capacity for meta-cognitive control of their learning process, enabling them to monitor and select learning approaches that work best for them in different learning situations (A. Y. Kolb, 2005).

For Kolb's experiential learning, there are four different learning modes: concrete experience (CE), reflective observation (RO), abstract conceptualisation (AC), and active experimentation (AE). According to Kolb (2005) that those four modes of learning can change over time states it and individuals can develop transforming learning preferences. Manolis (2013) re-demonstrates these modes along two continuums or dimensions — perceiving, the extent to which an individual emphasises abstractness over concreteness (AC–CE continuum), and processing, the extent to which an individual emphasises action over reflection (AE–RO continuum). An individual's learning style represents a combination of the two independent

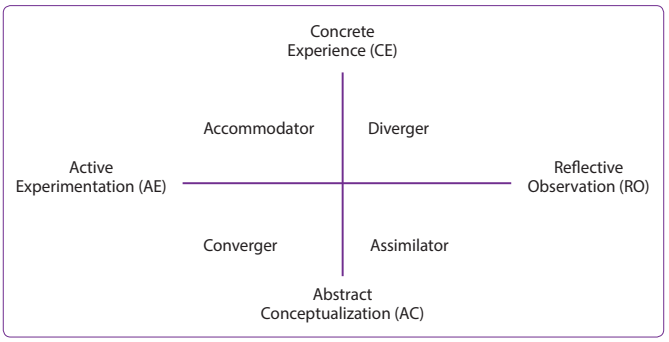

Figure 1. Kolb's Experiential Learning Model (Manolis et al., 2013).

dimensions. The four resulting learning styles are divergers (CE/RO), assimilators (AC/RO), convergers (AC/AE), and accommodators (CE/AE) (Figure 1).

According to these measurements, there are four types of Kolb's learning styles. The first learning style is described as convergence. Convergent learners have a tendency for abstract conceptualisation. The second one is divergence. Individuals with divergent learning styles combine reflective observation with concrete experience to device an often creative solution. The third learning style is called assimilation; with which individuals concerned with the explanation of their observations, favour abstract conceptualisation and reflective observation. They refine abstract theories. Finally, the fourth learning style is accommodation. Accommodated learners are good at using active experimentation and concrete experiments. Those individuals have a clear preference for hands-on learning (Cassidy, 2004; Manolis et al., 2013).

In this context, this paper focuses on new ways of revealing knowledge, creativity, and thus new adaptive tools in design education, which includes application of knowledge, and skills in new ways to achieve the goal of generating new knowledge and values. Experiential learning and learning by experience are very central to this generative process because architectural design education is conducted through learning by doing strategies. With this understanding, research was carried in the last 5 weeks of the fall semester of 2018 at Eskişehir Technical University Department of Architecture.[1] The study was maintained with the participation of novice students in the first semester of the design studio in architectural education.

[1] Eskişehir Technical University, Department of Architecture is an accredited department by the Architectural Education Accreditation Association (MİAK), where there are Studios of Introduction to Architectural Design and Basic Design as different courses at the same semester through the first year. The novice students are working on design principles and elements in the Basic Design course, while they are exercising spatial and structural issues in Introduction to Architectural Design Studio. In this sense, with an experienced academic staff, the structural and spatial arguments and abilities are instructed at an introductory level as a part of the course syllabus and catalogue of first-year design education for long years in Eskişehir Technical University.

Purpose of the Study

The purpose of this study is to examine if there is a correlation between the learning styles, spatial-visual perception and the creative design process. Through a case study, this research aims to interpret the findings for architectural design education in order to find if there are ways of generating learning environments more effective for the design students.

Method

In the research, the 17 novice students of architectural education were assigned with a multiphase design problem. The design process was realised, improved, and finalised within 5 weeks through studio discussions and critics. After the exercises were completed, the novice students are asked to participate in Kolb's learning style inventory and a spatial-visual perception test. The results of the inventory and the test were compared with and correlated to the students' performance in the studio for the given specific multiphase design exercise.

Methodologically, in the first step, the students were evaluated and assessed for their performance and design process regarding the criteria set specifically for all phases; in the second part, an inventory and a test were employed in order to determine the learning styles and spatial–visual capacities of the students; finally, the results of the design exercise and the tests were evaluated and compared (Table 1).

Content of the Design Exercise

The design exercise, which was carried out for the research, was composed of five successive interrelated parts, which are leading a knowledge production for the final submission of the design. In the design process, the novice students were expected to search, analyse, transform and interpret the information of fruit in order to reach at the end to the knowledge of a space, which is defined as a "shell for housing". The content and the five consecutive multiphase exercises can be counted as below (Table 2).

1- The first exercise was the "Section of a Fruit". Students were expected to cut fruit of their choice (pomegranate, walnut, cabbage, orange, pineapple, corn, and kiwi) longitudinally and transversely, then to draw the sections that transfer the inner structure of the fruit and the appearance of the fruit.

2- The second exercise was "Structural Abstraction". In this exercise, students were expected to reveal an architectural-3-dimensional pattern from the forms they created in fruit abstractions. This pattern had been consisted of regularly repeating units, and the details of the geometry of these units and how they were combined should be represented by models and drawings on a 1/5 scale.

3- Third was the "Structural Nub" exercise. Students were expected to transfer the structural information they have accessed, based on the width and length sections of a fruit they have chosen, to a model by taking into account the various structural relations, elements, and layers of the fruit. In this section, which is called the structural core of the fruit, they needed to transfer the relationships between the elements and the structural features with materials and methods depending on their preference, at a height of 30 cm, a width of 10 cm. They had the limitations of not using the photo block, corrugated board, etc., self-layered materials and adhesive materials that contain ready-made expressions.

4- In the fourth exercise, which is called "Transformation by Action", they had transformed the structural system relations of the model of the structure core they had developed. The novices were supposed to take into account the principles of body-space interaction of the actions of "resting, sitting and sleeping" that were previously examined, and presenting these relations

Table 1. Methodological phases of the research

1	2	3
Design Studio Exercises	Kolb's Inventory and Spatial–Visual Test	Evaluation of the Inventory and the Comparison with the Studio Performance

Table 2. Interrelated phases of the design exercise

1	2	3	4	5
Section of a Fruit	Structural Abstraction	Structural Nub	Transformation by Action	Shell for Housing

from a spatial perspective in 1/10 scale by drawing (plans and sections) and making a model as well.

5- The final exercise "Shell for Housing", was oriented by a fictional scenario of "There is a festival activity that will last for 1 week in İki Eylül Campus. There is a need for single-person accommodation units for the participants of this event to stay on campus during the event". Thus the students were expected to reconsider their structural and spatial designs "transformed by action" in the context of the space and scenario given to them in the İki Eylül Campus, within the body-space-environment relationship. They were required to question the temporality-permanence concepts in their designs. They needed to consider the natural and built elements that make up the physical environment where their areas were located. Creating open, semi-open, and closed spaces in their design should have been discussed in the context of internal-external relations. There were restrictions as to produce the designs in a volume of 15–20 cubic meters. Four specific spaces in the campus were given for the location of the shells.

When the first 4 steps of the design exercise came together, they revealed the structural and conceptual data in order to be interpreted for the final housing shell. Thus, regarding the spatial design, from an irrelevant source of data – the data of fruit – a concentrated spatial knowledge was aimed to be constructed. This is a creativity-boosting strategy in which there are unrelated elements that may not seemingly fit an architectural context, but when they are combined to reach a spatial solution, the result may step out of the accepted architectural paradigm. All parts of the studio work were evaluated under specific assessment criteria, the evaluation was recorded and delivered within a participatory environment among both the instructors and the students.

Assessment of the Exercises

The evaluations of each exercise were done via a four-point scale: Excellent, Average, Poor, Incomplete; and criteria for each exercise were determined with respect to their own requirements (Figure 2).

Kolb's Learning Style Inventory

Kolb's inventory was applied to the 17 novice students of architectural design education at the end of the semester, and they were evaluated according to their learning styles.

Spatial–Visual Perception Test

The second inventory used in the research is a visual and spatial perception test including some graphic, geometric and analytical questions gathered from different anonymous sources in order to assess the spatial imagination of the novice. The test also includes some drawing and perception questions in order to evaluate the spatial and three-dimensional perception of the participants. However, this test resulted in approximately the same and high scores for all the students that the effect of it in the correlation was neglected and was not taken into consideration. For this reason, all the novice students were accepted as spatially and visually potent.

Student's name:

Name of the work: Section of a Fruit	Date:			
Criteria	Excellent (3)	Average (2)	Poor (1)	Incomplete (0)
1- Does it demonstrate drawing of a section?	☐	☐	☐	☐
2- Structural features are represented	☐	☐	☐	☐
3- The quality of the drawing	☐	☐	☐	☐
Overall evaluation				

Name of the work: Structural Abstraction	Date:			
Criteria	Excellent (3)	Average (2)	Poor (1)	Incomplete (0)
1- The relation with the original fruit and the degree of abstraction	☐	☐	☐	☐
2- Existence of abstracted structural information of the fruit	☐	☐	☐	☐
3- The quality of the drawing and the model	☐	☐	☐	☐
Overall evaluation				

Name of the work: Structural Nub	Date.			
Criteria	Excellent (3)	Average (2)	Poor (1)	Incomplete (0)
1- Abstracted structural information of the fruit in the section-model	☐	☐	☐	☐
2- Layers of structural information with a discovered relationship	☐	☐	☐	☐
3- The balance of the representation accoding to the given size	☐	☐	☐	☐
4- Craftsmanship	☐	☐	☐	☐
Overall evaluation				

Name of the work: Transformation by Action	Date:			
Criteria	Excellent (3)	Average (2)	Poor (1)	Incomplete (0)
1- Structural info transformed regarding given actions	☐	☐	☐	☐
2- The potential of spatial features is observed	☐	☐	☐	☐
3-The quality of model	☐	☐	☐	☐
4- The quality of drawings	☐	☐	☐	☐
Overall evaluation				

Name of the work: Shell for Housing	Date:			
Criteria	Excellent (3)	Average (2)	Poor (1)	Incomplete (0)
1- Structural info transformed regarding given actions	☐	☐	☐	☐
2- The sectional and designerly information transfered to space	☐	☐	☐	☐
3- Material selection supports the design idea	☐	☐	☐	☐
4- The design includes closedness at some degree	☐	☐	☐	☐
5- The potential of the spatial organization	☐	☐	☐	☐
6- The relationship with the environment is considered	☐	☐	☐	☐
7- It reflects temporal design approach	☐	☐	☐	☐
8-The quality of model	☐	☐	☐	☐
9- The quality of drawings	☐	☐	☐	☐
Overall evaluation				

Figure 2. Assessment criteria for the phases of the design problem.

Table 3. The Number and Percentage of Students with respect to the Kolb's Inventory

	Converging		Assimilating		Diverging		Accommodating	
	Female	Male	Female	Male	Female	Male	Female	Male
Total 17	5	8	2	1	0	0	0	1
	13		3		0		1	
Percentage %	76,47058824		17,64705882		0		5,882352941	

Sample/Working Group/Participants

The working group in the research is formed by the participation of the 17 novice students in the first year of architectural education at Eskişehir Technical University. The design exercise is conveyed within the MIM 115 Introduction to Architectural Design Studio in the fall semester of 2018. These 17 "design learners" were asked to produce a design solution, to fill the inventory of Kolb's learning styles and to answer the spatial-visual perception test.

Table 4. The Evaluation Table of the Kolb's Inventory and the Spatial Test

		KOLB'S LEARNING STYLE EVALUATION																SPATIAL PERCEPTION TEST											
DESIGN GRADE	PARTICIPANT		1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	SK-SY	AY-YG	1	2	3	4			5	6				
75	1	1 SY -CONCRETE EXPERIENCE	3	3	4	1	2	4	4	2	1	2	2	3	31	-2	-6	1	1	1	1	1	1	0	0	1	1	1
		2 YG-REFLECTIVE OBSERVATION	4	4	3	2	4	3	1	3	3	1	1	2	31						orta				yok	az		
		3 SK-ABSTRACT CONCEPTUALIZATION	1	2	1	3	3	1	3	4	4	3	4	4	33													
		4 AY-ACTIVE EXPERIMENTATION	2	1	2	4	1	2	2	1	2	4	3	1	25													
85	2	1 SY -CONCRETE EXPERIENCE	2	2	4	2	4	3	2	4	1	3	1	1	29	0	-2	0	1	1	1	1	1	0	0	1	1	1
		2 YG-REFLECTIVE OBSERVATION	4	4	2	4	2	2	1	3	2	1	3	4	32						orta				yok	az		
		3 SK-ABSTRACT CONCEPTUALIZATION	3	3	3	1	1	1	4	1	4	2	4	2	29													
		4 AY-ACTIVE EXPERIMENTATION	1	1	1	3	3	4	3	2	3	4	2	3	30													
60	3	1 SY -CONCRETE EXPERIENCE	1	3	4	1	4	3	1	3	1	2	2	1	26	-3	7	1	1	1	1	1	1	1	1	3	3	2
		2 YG-REFLECTIVE OBSERVATION	4	4	1	3	2	2	3	2	2	1	1	4	29						iyi				var	iyi		
		3 SK-ABSTRACT CONCEPTUALIZATION	2	2	3	2	1	1	4	1	3	3	4	3	29													
		4 AY-ACTIVE EXPERIMENTATION	3	1	2	4	3	4	2	4	4	4	3	2	36													
50	4	1 SY -CONCRETE EXPERIENCE	3	3	4	3	3	2	1	1	2	1	1	1	25	-6	-4	1	1	1	1	1	1	1	0	3	3	2
		2 YG-REFLECTIVE OBSERVATION	4	4	3	2	2	1	4	3	1	2	4	4	34						iyi				yok	iyi		
		3 SK-ABSTRACT CONCEPTUALIZATION	2	1	2	1	4	3	3	4	3	3	3	2	31													
		4 AY-ACTIVE EXPERIMENTATION	1	2	1	4	1	4	2	2	4	4	2	3	30													
95	5	1 SY -CONCRETE EXPERIENCE	3	4	4	1	4	1	2	4	4	4	2	1	34	2	-2	1	1	1	1	1	1	1	0	3	3	2
		2 YG-REFLECTIVE OBSERVATION	1	2	2	4	1	2	4	2	1	2	4	3	28						iyi				yok	iyi		
		3 SK-ABSTRACT CONCEPTUALIZATION	2	1	3	3	2	4	1	3	3	3	3	4	32													
		4 AY-ACTIVE EXPERIMENTATION	4	3	1	2	3	3	3	1	2	1	1	2	26													
95	6	1 SY -CONCRETE EXPERIENCE	1	4	4	1	4	4	3	3	2	2	4	4	36	11	-1	1	1	1	1	1	1	0	1	3	3	2
		2 YG-REFLECTIVE OBSERVATION	4	3	3	4	2	3	1	4	1	1	1	3	30						orta				var	iyi		
		3 SK-ABSTRACT CONCEPTUALIZATION	3	1	1	2	1	1	4	1	4	3	3	1	25													
		4 AY-ACTIVE EXPERIMENTATION	2	2	2	3	3	2	2	2	3	4	2	2	29													
90	7	1 SY -CONCRETE EXPERIENCE	1	4	3	1	3	4	4	2	3	2	2	4	33	7	-3	1	1	1	0	0	0	0	1	0	0	2
		2 YG-REFLECTIVE OBSERVATION	4	3	4	2	4	3	3	3	1	1	1	3	32						anımsız				var	yz		
		3 SK-ABSTRACT CONCEPTUALIZATION	3	2	1	3	2	1	2	1	4	3	3	1	26													
		4 AY-ACTIVE EXPERIMENTATION	2	1	2	4	1	2	1	4	2	4	4	2	29													
85	8	1 SY -CONCRETE EXPERIENCE	1	3	4	1	3	4	4	3	2	2	2	4	33	4	2	1	1	1	1	1	1	1	0	1	1	1
		2 YG-REFLECTIVE OBSERVATION	4	4	3	3	4	2	1	1	1	1	1	3	28						iyi				yok	az		
		3 SK-ABSTRACT CONCEPTUALIZATION	3	2	1	2	1	1	3	4	4	3	3	2	29													
		4 AY-ACTIVE EXPERIMENTATION	2	1	2	4	2	3	2	2	3	4	4	1	30													
50	9	1 SY -CONCRETE EXPERIENCE	2	3	4	1	3	4	3	1	3	2	1	3	30	2	-4	1	1	1	0	0	0	0	1	3	3	2
		2 YG-REFLECTIVE OBSERVATION	4	4	3	2	4	2	1	4	1	1	3	4	33						tanımsız				var	iyi		
		3 SK-ABSTRACT CONCEPTUALIZATION	1	2	2	3	2	1	4	2	2	3	4	2	28													
		4 AY-ACTIVE EXPERIMENTATION	3	1	1	4	1	3	2	3	4	4	2	1	29													
50	10	1 SY -CONCRETE EXPERIENCE	1	3	4	1	2	3	2	3	3	1	2	4	29	0	2	1	1	1	1	1	1	1	1	1	1	1
		2 YG-REFLECTIVE OBSERVATION	4	4	1	2	4	2	3	4	1	2	1	2	30						iyi				var	az		
		3 SK-ABSTRACT CONCEPTUALIZATION	2	1	2	3	3	1	4	1	2	3	4	3	29													
		4 AY-ACTIVE EXPERIMENTATION	3	2	3	4	1	4	1	2	4	4	3	1	32													
65	11	1 SY -CONCRETE EXPERIENCE	1	4	4	1	4	4	4	4	2	2	1	1	32	4	-2	0	1	1	1	1	1	1	1	3	2	2
		2 YG-REFLECTIVE OBSERVATION	3	3	2	4	2	3	2	2	1	1	4	4	31						iyi				var	orta		
		3 SK-ABSTRACT CONCEPTUALIZATION	4	1	3	3	1	1	1	1	4	4	3	2	28													
		4 AY-ACTIVE EXPERIMENTATION	2	2	1	2	3	2	3	3	3	3	2	3	29													
55	12	1 SY -CONCRETE EXPERIENCE	1	3	4	1	2	2	2	3	2	2	2	2	26	-3	5	1	1	1	0	0	0	0	0	1	1	1
		2 YG-REFLECTIVE OBSERVATION	4	4	3	4	4	4	1	2	1	1	1	1	30						tanımsız				yok	az		
		3 SK-ABSTRACT CONCEPTUALIZATION	3	1	1	2	1	1	4	1	4	4	3	4	29													
		4 AY-ACTIVE EXPERIMENTATION	2	2	2	3	3	3	3	4	3	3	4	3	35													
56	13	1 SY -CONCRETE EXPERIENCE	3	2	1	4	2	3	2	4	4	4	2	2	33	2	-2	1	1	1	1	1	1	1	1	3	2	2
		2 YG-REFLECTIVE OBSERVATION	1	3	3	1	3	1	4	2	3	1	4	3	29						iyi				var	orta		
		3 SK-ABSTRACT CONCEPTUALIZATION	2	4	4	3	1	4	1	3	1	3	1	4	31													
		4 AY-ACTIVE EXPERIMENTATION	4	1	2	2	4	2	3	1	2	2	3	1	27													
55	14	1 SY -CONCRETE EXPERIENCE	1	1	3	1	4	2	1	2	2	1	3	2	23	-12	-2	1	1	1	1	1	1	1	1	2	3	2
		2 YG-REFLECTIVE OBSERVATION	3	4	4	3	1	1	4	4	1	2	2	3	32						iyi				var	orta		
		3 SK-ABSTRACT CONCEPTUALIZATION	4	3	1	2	2	3	3	3	3	3	4	4	35													
		4 AY-ACTIVE EXPERIMENTATION	2	2	2	4	3	4	2	1	4	4	1	1	30													
73	15	1 SY -CONCRETE EXPERIENCE	4	2	3	4	3	3	3	3	2	4	2	1	34	-2	0	1	1	1	1	1	1	1	0	3	3	2
		2 YG-REFLECTIVE OBSERVATION	1	3	2	3	1	1	1	1	4	2	4	2	25						iyi				yok	iyi		
		3 SK-ABSTRACT CONCEPTUALIZATION	3	4	4	2	2	4	2	4	3	1	3	4	36													
		4 AY-ACTIVE EXPERIMENTATION	2	1	1	1	4	2	4	2	1	3	1	3	25													
75	16	1 SY -CONCRETE EXPERIENCE	2	2	4	1	4	3	1	4	1	2	2	1	27	-1	0	1	1	1	1	0	0	1	0	0	3	2
		2 YG-REFLECTIVE OBSERVATION	3	4	3	3	1	4	3	3	2	1	1	4	32						az				yok	orta		
		3 SK-ABSTRACT CONCEPTUALIZATION	4	1	1	2	2	1	4	1	3	3	4	2	28													
		4 AY-ACTIVE EXPERIMENTATION	1	3	2	4	3	2	2	2	4	4	3	2	32													
66	17	1 SY -CONCRETE EXPERIENCE	1	4	4	1	3	3	2	4	3	2	2	1	30	-1	-5	1	1	1	1	1	0	0	0	3	2	2
		2 YG-REFLECTIVE OBSERVATION	4	3	3	3	2	2	4	3	2	1	1	4	32						az				yok	orta		
		3 SK-ABSTRACT CONCEPTUALIZATION	2	2	1	2	4	1	3	2	4	4	4	2	31													
		4 AY-ACTIVE EXPERIMENTATION	3	1	2	4	1	4	1	1	1	3	3	3	27													

Data Collection Instruments/Data Collection Methods/ Data Collection Techniques

The data for the research is collected via digital and analogical techniques. The visual and written design proposal of the students for all phases of the studio exercise were collected and archived digitally in a specific folder created for the lecture. During the semester, the exercises were assessed successively according to the criteria set for each. The grades were recorded in digital tables as well.

The Kolb's inventory and the spatial test were applied all students at the same time through hard copy written documents and the participants were given sufficient time to fill the tests. The answers of the students were evaluated and uploaded to the digital evaluation tables in order to control and compare the results.

Results

Seventeen students had participated in the research; they designed a shell for housing, filled out Kolb's learning styles inventory and the spatial test. According to the results of Kolb's learning styles inventory, most of the students have a convergence type of learning. In other words, 76.4% of the students are "convergent", 17.6% are "assimilator" and 6% are "accommodator". Interestingly there is no student with a "divergence" type of learning (Tables 3 and 4).

Regarding the studio exercise, the evaluation of the performance of the participant 17 students has a variable scale with respect to the grades they have. According to this comparison, it is observed that students with the learning style of "assimilation" had the highest scores of the design exercise (Table 5).

Another medium to read the results of this research is the holistic charts. The visual and three-dimensional submissions of the 17 attendees are listed and classified holistically via a chart (Figure 3). In this chart, all five phases of the design process and all the design products submitted by the students are seen as a whole, as well as the information of the preferred fruits. By means of this documentation, it is possible not only to follow the articulation of the design process and the elaboration of the design idea but also to compare the individual differences among the students. A horizontal look serves for a student's own process for all phases, while a vertical look provides a comparison for a specific phrase. In this visual table, there are some blank cells because the students did not upload the related visual documents even though they had submitted those phases of the design. So the blank cells do not mean an incomplete submission, conversely, all 17 students had completed all the steps and could be evaluated for all phases of the exercise.

Table 5. Design Grades and the Learning Style of the Students

	ASSIGNED FRUIT	1- SECTION OF A FRUIT	2- STRUCTURAL ABSTRACTION	3- STRUCTURAL NUB	4- TRANFORMATION BY ACTION	5- SHELL FOR HOUSING	KOLB'S LEARNING STYLE
STUDENT 1	ORANGE		75				CONVERGING
STUDENT 2	ORANGE		85				CONVERGING
STUDENT 3	PINEAPPLE		60				ACCOMODATING
STUDENT 4	CORN		50				CONVERGING
STUDENT 5	POMEGRANATE		95				CONVERGING
STUDENT 6	WALNUT		95				ASSIMILATING
STUDENT 7	CABBAGE		90				ASSIMILATING
STUDENT 8	CABBAGE		85				ASSIMILATING
STUDENT 9	PINEAPPLE		50				CONVERGING
STUDENT 10	PINEAPPLE		50				CONVERGING
STUDENT 11	KIWI		65				CONVERGING
STUDENT 12	WALNUT		55				CONVERGING
STUDENT 13	CABBAGE		55				CONVERGING
STUDENT 14	CORN		56				CONVERGING
STUDENT 15	KIWI		73				CONVERGING
STUDENT 16	ORANGE		75				CONVERGING
STUDENT 17	KIWI		66				CONVERGING

Discussion and Conclusion

After the results are interpreted, it is seen that there is an acceptable pattern about the grades and the learning style of the students. As stated in Table 6, most of the students who participated in this research are identified as convergers. Therefore, the students with the converging learning style have varying grades from 50 to 95. However, it can be seen that the lowest 3 scores are from the convergent types of students, which may lead us to think that: "The students with converging learning styles are not satisfactory for this design exercise"

On the other hand, one of the highest scores of this exercise -which is 95- is gained by a convergent student. This data can be interpreted as: "The students with converging learning styles can be promising for this design exercise, too."

Another obvious pattern from Table 6 is all the students with the assimilating learning style are seen on the highest score list without any exception. From this pattern, it can be stated that: "The students with assimilating learning styles are more promising for this design exercise compared to the other students with other learning styles."

In addition to the direct interpretations from the Table, it is important to see the works of the students in detail, which may constitute the indirect correlations such as the quality of the work and the degree of spatial adaptation of the data gathered from the body of fruit. Figures from 4 to 8 demonstrate the visual materials submitted by the students of different learning styles. Figures 4 and 5 shows

Figure 3. Students' Work for Different Phases of the Design Problem.

the design process of the assimilator participants where the information from the selected fruit is successfully adopted to the shell for housing. This success comes from the satisfied design criteria determined for the 5 separate

Table 6. The Relation of the Grades and the Learning Style

	Assigned Fruit	Final Grades	Kolb's Learning Style
Student 5	Pomegranate	95	Converging
Student 6	Walnut	95	Assimilating
Student 7	Cabbage	90	Assimilating
Student 2	Orange	85	Converging
Student 8	Cabbage	85	Assimilating
Student 1	Orange	75	Converging
Student 16	Orange	75	Converging
Student 15	Kiwi	73	Converging
Student 17	Kiwi	66	Converging
Student 11	Kiwi	65	Converging
Student 3	Pineapple	60	Accommodating
Student 14	Corn	56	Converging
Student 12	Walnut	55	Converging
Student 13	Cabbage	55	Converging
Student 4	Corn	50	Converging
Student 9	Pineapple	50	Converging
Student 10	Pineapple	50	Converging

*The Highest 3 Scores Of The Exercise
*The Lowest 3 Scores Of The Exercise

phases of the design process and from the quality of the work as well.

Figures 6 and 7 demonstrate the works of the students with the convergent learning style. The common point of these works is the repetition of an abstracted element derived from the fruit only in a formal manner. However, the questioning and then the abstracting of the fruit should provide a structural transfer instead of a decorative formal adaptation. Moreover, the combination of the structural parts of the fruit could be repeated on a spatial dimension. Therefore, this kind of formalist design approach was evaluated as insufficient even the quality of the work is good enough. As a recurring pattern, it is seen that the "converger" students has the same tendency of using the information of the fruit perceiving its formal qualities instead of its structural qualities except for students 1, 2, 15, and 16. Those students having a convergent learning style had used the structural potentials of the fruit differently from the formalist handlings; however, the imbalance in the quality and approach among phases had resulted in average grades.

There is only one student with an accommodating learning style. Regarding the application of the data from the fruit, the work of the "accommodator" is also similar to the ones with the formalist approach. Furthermore, the forms were deformed arbitrarily and connected to each other by an artificial additional-secondary construction method. A natural structural connection derived from the intrinsic condition of the fruit was of great importance in this design exercise, through which the new knowledge could be gathered both spatially and structurally. Yet, the accommodating student has failed to discover this potential (Figure 8).

Evaluating the works of 2 assimilating, 2 converging and 1 accommodating student in detail put some critical

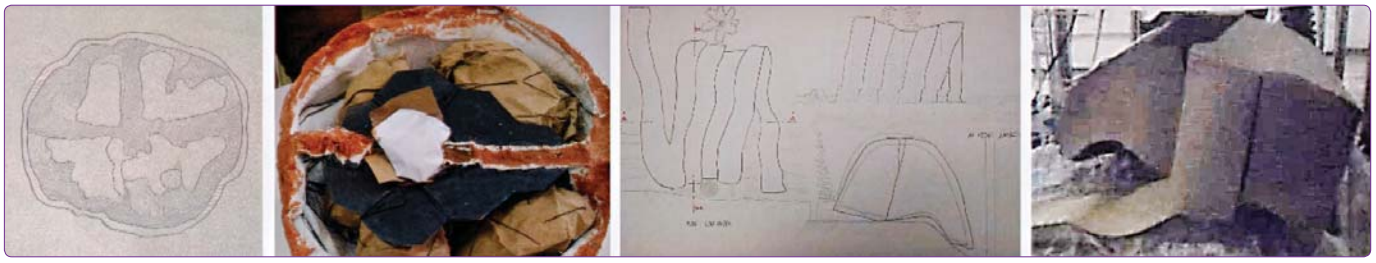

Figure 4. Student 6's work: design from walnut to a shelter: Section - abstract model-drawings and model of the shelter (successively) –Assimilating-grade: 95.

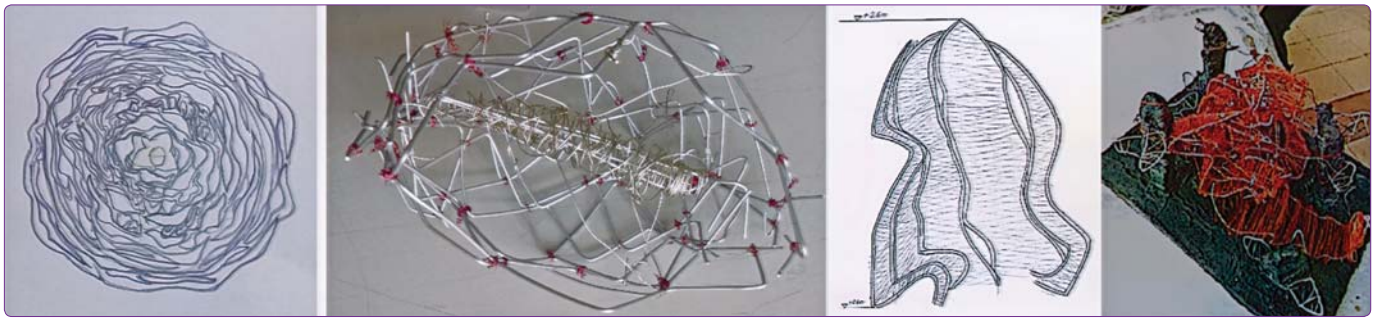

Figure 5. Student 8's work: design from cabbage to a shelter: Section - abstract model-drawings and model of the shelter (successively) - Assimilating-grade: 85.

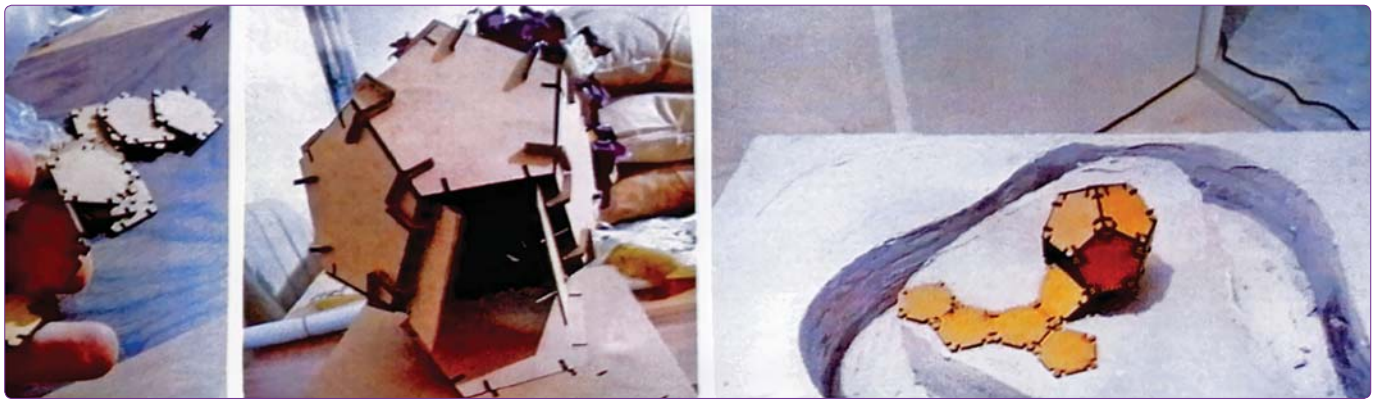

Figure 6. Student 10's work: design from pineapple to a shelter: model of the shelter, an abstract form derived from the pineapple applied to the design just as a façade - Converging-grade: 50.

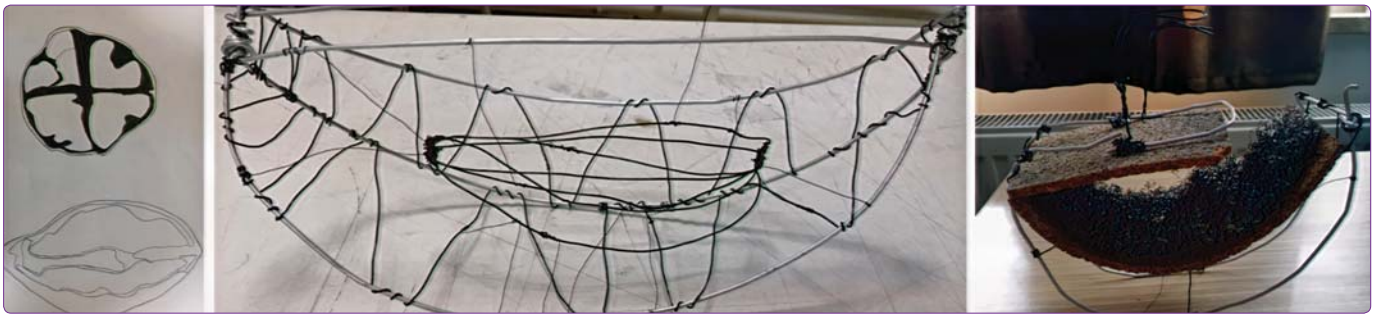

Figure 7. Student 12's work: design from walnut to a shelter: section of the walnut, structural nub and the model of the shelter, an abstract form derived from the walnut applied to the design neglecting the structural capacity - Converging-grade: 55.

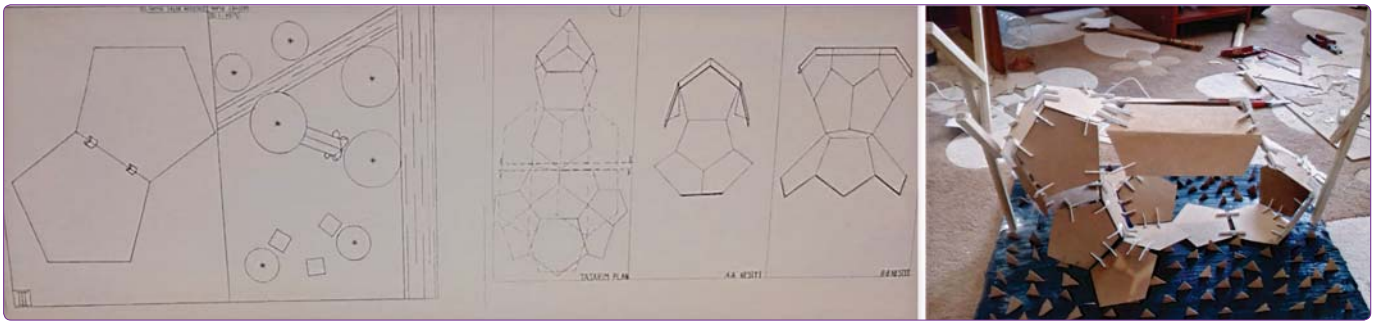

Figure 8. Student 3's work: design from pineapple to a shelter: model of the shelter, an abstract form derived from the pineapple applied to the design by an artificial construction method. Accommodating - grade: 60.

points forward for this research. Among 17 participants, there are some clear acceptable correlations between the learning styles and the success of this design exercise. It is seen that the assimilators are more successful than the other types of learners. Convergers can be accepted both as successful and unsuccessful specific to this study and it is hard to make a clear statement about them, however; it is obvious that there is a reductive tendency of convergers when the dominant formalist design approach of them is concerned. Finally, the number is not sufficient to make an inference for accommodating learners.

For an overall comment, it is not concrete that if there is an effect of the selection of the fruit at the first step on the success of the student. Yet, having all types of students in all types of fruits with varying grades can be an unintended reply for the limitation of this research against the possible effect of the match of the fruit.

Concerning the general outputs of the research, it is understood that the prevalence and application of such inventories and tests in order to recognise the students learning styles in design education and to deepen the research to reveal its effects on design learning is a critical field of study. Thus, the repetition of such experiments

with different students, or assigning new exercises to the same group of participants may both decipher new paths in design teaching methods. As the results of this initiative study deciphered, new tools and new research patterns may be developed. One of these new approaches could be the digitalising of Kolb's inventory and the usage of it for the distanced design education as well. Another one could be the application of the inventory for the same sample group at the last year of their education and evaluate if there is a difference in learning styles over time. This data could also be utilised for other design exercises to construct correlational relations.

The contribution of this study to design research, based on a studio study, is to reveal the reality of student's personal way of learning, designing, and creating is the main determinant of the training given in the design studios. This study shows once again that in an era where production of knowledge is very crucial, a fertile field such as design should be primarily considered as many areas of education as in architectural education.

It is important to create course content, syllabus, and thus specific exercises according to abilities and learning tendencies of design students which can be adapted to their personal preferences and aptitudes. Generally, architectural design studios present design exercises with a limited types of teaching methods suit only to a limited types of learning. While creativity, knowledge, and learning style are personal, offering a standard design education is irrational which is generally understood as the preference of an experimented and known method for all. Therefore, design schools should reconsider their curricula according to this plurality of individual apprehension.

Providing that we create an architectural design course content that targets all types of learning which can answer students' needs to enhance their capabilities and learning styles, it is necessary to adopt new methods for design teaching-learning and evaluation to reach the full potential of creativity and production of knowledge.

Another output of the research is the necessity that the studio works, and student personalities should be superposed holistically, and the exercises should be done accordingly to the students learning styles. In this superposition, it is significant to learn about the students' background, abilities, and learning styles before concentrating on how to teach them creativity or to design. It is more critical to study who to teach than what or how to teach. Therefore, it is important to determine the learning styles of each student at the very beginning of their education.

There arise some questions that "Is the architectural design problems and phenomena are inclined to the type of "assimilation" learning style?" or "Did nearly 77% of the students with a "convergent" learning style choose the wrong profession?" "Could the learning style be changed after receiving design education?" or "Do we miss the potential of individuals with the remaining types of learning other than "assimilators", by concentrating on their higher scores as a consequence of similar exercises favouring the same abilities hitherto?" Some of those questions may find an answer, yet some of them are open-ended and have not one clear answer having roots in the philosophy of design and design thinking.

According to the research some future projections may be done. Design exercises could be classified according to the students learning styles. After this classification, and after the determination of the learning habits of the novice designers, some creativity-boosting matches can be tested. This is a time taking and challenging process through which many variables and potentials could be discovered. From a tested archive of the design exercises, a new flexible curriculum can be formed which is adaptive and sensitive to the learning approaches of the students. In this way, keeping in mind the necessities of design teaching and learning, a semi-personal, dynamic and in flux, attitude can be developed for curriculum design. In acceptation of this research is just a beginning and these rates are not sufficient to make a definite judgment, they provide hints that this research should be furthered and repeated in terms of different design problems. This research shows that evaluating students' design skills only according to their learning styles is not sufficient alone, but success in design skills may also be related to other factors. Accordingly, while Kolb's learning style scale can be a good starting tool to make these comparisons, it should be accepted that different parameters should also be considered.

References

Amabile, TM. (1996). Creativity in context (Boulder, CO, Westview Press).

Cassidy, S. (2004). Learning styles: An overview of theories, models, and measures. Educational psychology, 24(4), 419-444.

Cross, N. (1982). Designerly ways of knowing. Design studies, 3(4), 221-227.

Csikszentmihalyi, Mihaly. (1997). Flow and the psychology of discovery and invention. HarperPerennial, New York, 39.

Demirbaş, Ö.O. (2001). The Releation of Learning Styles and Performance Scores of the Students in Interior Architecture Education, Doktora Tezi, Bilkent Üniversitesi Sosyal Bilimler Enstitüsü, İç Mimarlık ve Çevre Tasarımı Anabilim Dalı, Ankara.

Dewey, J. (1986). Experience and education. Paper presented at the Educational Forum.

Kaufman, James C, & Baer, John. (2005). Creativity across domains: Faces of the muse: Psychology Press.

Kolb, A. Y. (2005). The Kolb learning style inventory-version 3.1 2005 technical specifications. Boston, MA: Hay Resource Direct, 200, 72.

Kolb, D. A. (2014). Experiential learning: Experience as the source of learning and development: FT press.

Kwan T., Yunyan, J. (2005). Students' Learning Styles and Their Correlation with Performance in Architectural Design Studio¬, Design Studies, 26(1): 19-34. https://doi.org/10.1016/j.destud.2004.06.004

Lawson, B. (2006). How designers think: The design process demystified. Routledge.

Manolis, Chris, Burns, David J, Assudani, Rashmi, & Chinta, Ravi. (2013). Assessing experiential learning styles: A methodological reconstruction and validation of the Kolb Learning Style Inventory. Learning and individual differences, 23, 44-52.

Özdemir, E.E. (2013). Mimarlık eğitiminde tasarım sürecinin geliştirilmesi yönünde bir yöntem arayışı, [Unpublished doctoral dissertation]. Gazi Üniversitesi Fen Bilimleri Enstitüsü Mimarlık Anabilim Dalı, Ankara.

Peters, M. A., Marginson, S., & Murphy, P. (2009). Creativity and the global knowledge economy: Peter Lang.

Polanyi, M. (1958). Personal Knowledge: Towards a Post-Critical Philosophy Routledge. Paul, London.

Pope, Rob. (2005). Creativity: Theory, history, practice: Routledge.

Salama, A. (1995). New trends in architectural education: Designing the design studio: Arti-arch.

Schön, D. A. (1985). The design studio: An exploration of its traditions and potentials: International Specialized Book Service Incorporated.

Tezel, E., Casakin, H. (2010). Learning Styles and Students' Performance in Design Problem Solvin. International Journal of Architectural Research, 4(2-3): 262- 277.