



The Effects of Model Making on Design and Learning in Landscape Architecture Education

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ABSTRACT

Purpose: One of the modeling methods used in the training of all design disciplines is physical model making. This study investigates the model-making technique and emphasizes the positive effects of model-making and its utility in the academic setting in order to understand its effects on design and learning. The "Equipment Design" course, taken in the 3rd academic semester at the Landscape Architecture Department at Karadeniz Technical University, was addressed as the application for this study. This course aims to convey to students the knowledge of how to utilize equipment in the design process in terms of ergonomics and aesthetics. The

objective of the course is to design creative equipment that has appropriate dimensions and form that integrates with the selected activity. During the course, the students were assigned a sitting activity as a design problem and asked to design unique seating equipment and to express it through a model. **Research Methods:** In the first phase, the intention was to explore how students analyzed the seating activity through the model and how they interpreted the relationships among the dimensions, form and equipment in their designs, and thus equipment models were investigated accordingly. In the second phase, a survey study developed examines the effects of the model technique on the design process and student learning. Thus, the effects of the model-making technique on the level of teaching in the Equipment Design course were determined. **Findings:** Consequently, it was determined that students' notions of design develops through model making and that making a model of the seating equipment was found to be an instructive method for students of landscape architecture in terms of dimensions, form and material. **Implications for Research and Practice:** The "Equipment Design" course can contribute to the design processes of students especially in terms of creativity and realism. The model making approach facilitates students' understanding of dimension, form and the dimension-form relationship and material and the material-form relationship in the learning process, while contributing greatly to the development of the students' design processes.

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Introduction

Model making facilitates the design to be formed, making it clearer and more precise in comparison to other two-dimensional communication techniques. Models are forms of three-dimensional representations that create environments and allow us to perceive and interpret the design in greater depth than representation via drawing. Although design studies are finalized and solved on two-dimensional digital and physical platforms, the product might not be fully meaningful until it is physically produced in a three-dimensional platform (Donath & Regenbrecht, 1996; Dunn, 2010).

Visual models such as physical models help designers in their decision-making process, in addition to facilitating students in design and presentation of the current construct in terms educational functions. According to Golderman and Hoogen boom (2001), “visualization is the transformation of a spatial object into two- or three-dimensional models, organized by representations, simulations, and animations in a manner that could be perceived by the human mind, subsequent to design, implementation, and post-implementation”. Visualization is important as an assistive tool in decision-making and for allowing the experience and comprehension of changes before they are actualized (Lange & Bishop, 2005). In the visualization of design, the representation techniques used are grouped into two, namely the conventional and the digital (Goldschmidt & Smolkoy, 2006; Jones, 1992; Shaw, 1994). The modeling technique is different realistically from the conventional techniques of representation (two-dimensional drawing, three-dimensional drawing, model technique). In the process of solving any design problem, primarily, abstract design ideas are first formed in the student’s mind (Balta, 1999). However, the greatest challenge for freshmen in design education is to interpret and visualize the relationships within their design product during the process (Akbulut, 2010; Svoboda, 1992). The first step the student must take is to visualize the ideas in his/her mind by using tangible tools such as paper and the pencil or a model. In this respect, a model is highly effective and useful, as it reflects reality. When considered from this perspective, a model stands out not only as a design tool that is a physical representation establishing a relationship between the idea and reality, but also as a real object. Entire details of the design can be demonstrated directly through the model. Contrary to linear perspective drawings that offer a single angle view it is possible to move around the model, and the model can be moved to evaluate the design from many different angles (Spankle, 2009).

Consequently, the model emerges as a platform that provides ease of perception and facilitates a more distinct and effective delivery of the entirety of the features of design ideas (Dunn, 2010). Design educators must generate knowledge based on their distinctive methodological approaches and subscribe to their techniques by incorporating these methodical productions of knowledge into knowledge transfer. Therefore, this study aims to contribute with a distinct design technique focusing on the process of model-making techniques in landscape architecture design education (Durling, Cross, & Johnson, 1996; Galambos, Abelson, & Black, 1986; Oxman, 2004). The study intends to shed light on landscape architecture education by demonstrating the effects of this technique on learning and design processes.

Design Education and Equipment Design

Students are expected to produce convenient creative designs by integrating the design processes in the landscape architecture educational process since landscape architects need to develop multidimensional cognitive abilities. Equipment design education is a part of this process and aims to teach the means for designing unique equipment in accordance with the specific activity. Therefore, students need to cope with many different circumstances simultaneously while producing the options for equipment design. A few of these circumstances are aesthetic and functional considerations, namely, the dimensions of the equipment, its form, shape, the type of activity it is meant for, and the relationship of the equipment to the activity. Thus, at the Department of Landscape Architecture at Karadeniz Technical University (KTU), theoretical and applied design studio courses, where a master-apprentice relationship becomes the frontline, are considered extremely important for students to develop design and creativity skills. The Equipment Design course is one of these courses. In this study, the Equipment Design course, which aims to develop a creative understanding of equipment design, is examined within landscape architecture education.

Once the individual is considered as a system together with the equipment he or she utilizes in his/her inhabited environment, a harmony between the user and the equipment becomes necessary for this system to operate effectively (Yildirim & Hacibaloglu, 2000). Seating equipment has become a part of people's lives and is the most intensively used type of equipment. Therefore, it is crucial for students of landscape architecture to learn the design of the equipment most often used in open urban spaces. The surface essential to actualize the action of sitting could be a part of seating equipment with a certain height, as well as the ground plane. Designs that meet and solve the requirements of a sitting action are considered and formed according to the parameters of different environments and the purpose of the sitting action in the particular environment (Keegan, 1962). However, since human physiology cannot be altered, the sitting activity should ensure anthropometric measures and ergonomic conditions in any environment (Altiparmakogullari, 2009). Designers, therefore, first need to design ergonomic, unique, and creative seating units (Casakin, 2007; Cubukcu & Dundar, 2007). In this context, the models for seating units built in the Equipment Design course, which aims to investigate the design of ergonomic and original equipment, were evaluated within the education of the Department of Landscape Architecture.

Method

Research Design

Scale models at 1/20th the size of seating units designed by students for sitting activities in the “Equipment Design” course, a second-year course at the Department of Landscape Architecture at KTU, were used as the material for this study. Landscape architects create habitable spaces for users by designing the environment to align with people’s requirements and desires. In the discipline of landscape architecture, while designing these habitable spaces, first, ergonomic functional designs that meet the requirements of the users and then aesthetically unique designs with the highest level of creativity should come into prominence. Therefore, this course aims to convey to students an understanding of designing and developing creative equipment with appropriate dimensions, materials, and forms convenient for the activity. More explicitly, within the scope of this course, students are informed in regard to topics such as equipment elements, types, dimensions, and spatial construct. Subsequently, the equipment cases designed all over the world are examined in terms of space-equipment relationships.

Research Sample

During the later phases of the course, 30 students who attended the course were required to design a piece of equipment at 1/20th scale for a sitting activity. The aim was to ensure that students grasped the notion of designing seating fixtures in appropriate dimensions and unique forms. The educational approach within this course concentrates on the provision of formal and functional integrity. Depending on the selected sitting activity, the students are expected to interpret and design an original seating unit in the correct dimensions and form and to express it through a physical model.

In this course, which was organized directly through the utilization of a modeling technique, the main aim is to think, research, build, attempt, and design through a physical model. Students were free to choose their selection of material in order to let them decide on the appropriate material for the imagined form and to conduct trials in terms of finding the right technique related to the nature of the material by enhancing harmony between the material and the form.

Students would first examine examples of conceptual and tangible seating equipment in the literature in order to decide on the form to be used in the model. In this manner, they were to decide on the original character they would employ in their work. Subsequent to the literature survey conducted during this phase, the students begin to work on the model, through which they transferred their ideas of discovery, shaping, and developing into a three-dimensional representation. During the 6-week period, the models evolved and changed with respect to the criticisms of the course instructor. At the end of the process, an extraordinary, creative, and ergonomic product was achieved. The creative and unique 1/20th-scale seating units were submitted as the final models (Figure 1). In this phase, the students’ final models were evaluated in terms of dimensions, form, and creativity.



Figure 1. Seating unit models built in the scope of the course

Research Instruments and Procedures

At the end of the course, a questionnaire was administered in order to determine the contributions of the model technique used during the course to the design process and learning. The questionnaire constitutes phase two of the study and consists of two parts. In the first part, the effects of the model technique on design were investigated, and in the second part, the effects on learning were investigated. The students were asked to respond to a questionnaire with a five-point scale and asked to rate items using 1 (very little), 2 (little), 3 (fair), 4 (good), or 5 (very good).

To determine the contributions of the model technique to the design processes, the following questions were asked: (1) How useful is model making scientifically? (2) How useful is model making in terms of functionality? (3) How useful is model making in terms of realism? (4) How useful is model making in terms of creativity?

To determine the contributions of the model-making technique to the learning process, the following questions were asked: (1) How much did you learn about the

dimensions of seating equipment while making a model? (2) How much did you learn about form, finding appropriate to the activity during the model-making process? (3) How much did you learn about the relationship between dimensions and form during the model-making process? (4) How much did you learn about finding the appropriate material for the form during the model-making process? (5) How much did you learn about the relationship between material and form during the model-making process? Finally, the students were asked whether they found the model-making process useful in expressing their thoughts about educational life.

Data Analysis

The data were coded, loaded, and analyzed using the SPSS 23.0 statistical package program. The study's mean scores and standard deviation values were calculated. During the research period, the statistical package program benefited from obtaining the research results. An independent t test was used to identify the differences between the effects of the concepts on the process, while an ANOVA test was used to determine whether model making contributed more to the learning process than to the design process. A correlation analysis was used to determine the relationship between model making and the learning process.

Results

Results of Phase One

Dimension, form, and creativity solutions were analyzed for the models of seating units designed by the students within the scope of this course given in 2016. Students were required to design a piece of seating equipment at 1/20th scale. The models constructed by the students are evaluated in Table 1 in terms of dimensions, form, and creativity.

Table 1

Evaluation of Models for Dimensions, Form and Creativity

Evaluation					
Dimension	Ergonomic	+	+	+	-
	No-ergonomic	-	-	-	+
Form	Organic	+	+	-	-
	Linear	-	-	+	+
Creativity	Ordinary	-	-	-	+
	Original	+	+	+	-



Findings of the Questionnaire

Findings Related to the Effect of Model Making on the Design Process

“Creativity” and “Realism” attained the highest level of frequency values among the questions asked to determine the effects of model making on the design process (Figure 2). In other words, the model-making process was found to be highly beneficial in terms of developing creativity and expressing realism. “Formality” and “Functionality” were also found to be of assistance during the process.

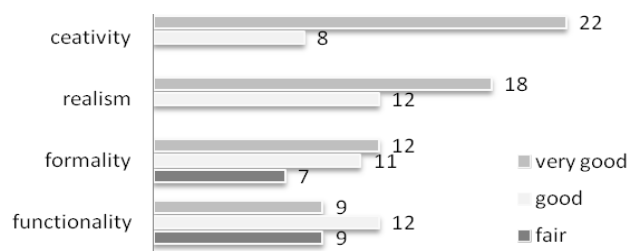


Figure 2. Frequency distribution graph of the effects of model making on the design process

Independent Samples t Test was performed using SPSS (v. 23.0) to determine whether the differences of the effects of the concepts on the process were statistically significant. The findings revealed that model making affected the design process in terms of creativity, realism, formality, and functionality ($p < 0.01$) (Table 2). Therefore, it is possible to assert that model making is an important factor in improving the design process for students.

Table 2

Evaluating the Differences Due to Model Making in the Design Process

	<i>t</i>	<i>df</i>	<i>Sig. (2-tailed)</i>	<i>Mean Difference</i>	<i>95% Confidence Interval of the Difference</i>	
					<i>Lower</i>	<i>Upper</i>
Creativity	57,641	29	,000	4,733	4,57	4,90
Realism	50,565	29	,000	4,600	4,41	4,79
Formality	28,834	29	,000	4,167	3,87	4,46
Functionality	27,809	29	,000	4,000	3,71	4,29

Findings Related to the Effect of Model Making on the Learning Process

“Form” attained the highest level of frequency value for the questions asked to determine the effects of model making on the learning process (Figure 3). In other words, model making contributed significantly to the learning process in terms of

form. The students learned about the relationship between dimensions and form and material and dimensions in equipment design at a good level and the relationship between equipment and form and material and form at a very good level while making the models.

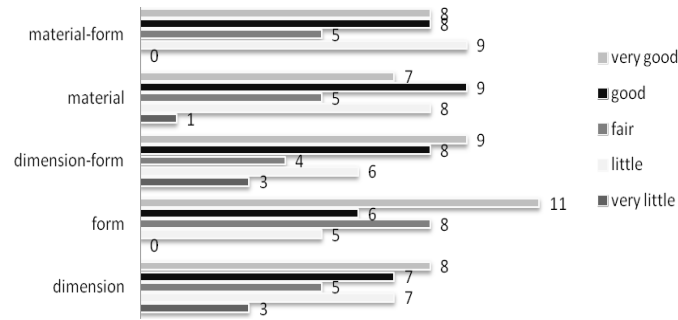


Figure 3. Frequency distribution graph of effects of model making on the learning process

Independent-Samples t test was performed using SPSS (v. 23.0) to determine whether the differences of the effects of the concepts on the process were statistically significant. The test results indicated that model making had a statistically significant effect on the learning process in terms of dimension, form, dimension–form relationship, material, and material–form relationship ($P < 0.01$) (Table 3). Therefore, it is possible to conclude that model making is an important factor in improving the learning processes of students.

Table 3

Evaluating the Differences Due to Model Making in the Learning Process

	<i>t</i>	<i>df</i>	<i>Sig. (2-tailed)</i>	<i>Mean Difference</i>	<i>95% Confidence Interval of the Difference</i>	
					<i>Lower</i>	<i>Upper</i>
Dimension	13,298	29	,000	3,333	2,82	3,85
Form	18,175	29	,000	3,767	3,34	4,19
Dimension-Form	13,730	29	,000	3,467	2,95	3,98
Material	15,378	29	,000	3,433	2,98	3,89
Material-Form	16,025	29	,000	3,500	3,05	3,95

Comparison of Findings on the Benefits of Model Making

In this phase, the effects of model making on the design and learning process are compared. As an outcome of the ANOVA test, it was determined that model making contributed more to the learning process than to the design process (Table 4).

Table 4

The Evaluation of the Effect of Model Making on the Processes ANOVA

		<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
Design Process	Between Groups	5,619	4	1,405	8,073	,000
	Within Groups	4,350	25	,174		
	Total	9,969	29			
Learning Process	Between Groups	29,112	4	7,278	11,855	,000
	Within Groups	15,348	25	,614		
	Total	44,460	29			

Therefore, a correlation analysis was used to determine the relationship between model making and learning processes (dimension, form, dimension-form relationship, material, material-form relationship) and the benefits this process provided to students in regard to expressing their thoughts (Table 5). According to these results, the most effective factor in the learning process via model making was the material, and this was followed by the dimension-shape relationship. All factors were influential in the learning process. In addition, the ability to express ideas and material-form relationships, material and dimension were defined as the most interrelated concepts.

Table 5

Concepts Related to the Learning Process

		1	2	3	4	5
Learning Process	(1) Dimension	-	,937**	,969**	,958**	,966**
	(2) Form		-	,950**	,920**	,927**
	(3) Dimension-Form Relationship			-	,957**	,959**
	(4) Material				-	,978**
	(5) Material-Form Relationship					-
Benefit in expressing ideas		,790**	,680**	,738**	,793**	,814**

** . The correlation is significant at the level of 0.01 (2-tailed).

Discussion and Conclusion

As in all disciplines that include design and creativity processes, in academic landscape architecture programs, the approaches and methods that lead students to acquire the necessary skills and learn design are extremely important. In this study, which examined the relationships of model making to design and learning processes, the benefits of model making in equipment design were presented.

Within the scope of the Equipment Design course, on which this study was based, it was determined that model making contributes to the design processes of students, particularly in terms of “creativity” and “realism”. Furthermore, the applied model-making method helped design students with aesthetic, functional, and formal perspectives and rendered the design process more comprehensible. The model-making approach facilitated students’ understanding of dimension, form, dimension-form relationships, material, and material-form relationships in the learning process, while contributing greatly to the development of the students’ design processes.

Based on these results, physical models play an important role as a tool in design and learning. The primary factors that strengthen this role are emphasized in the introductory section of this study as models being easy-to-comprehend and having realistic textures and physical existence. Despite the indisputable advantages of today’s digital technologies and design world, such as the speed, variation, practical use, and sharing environment offered by 3D modeling software, physical models reveal a reality and form that can be observed from many different angles (Atalay et al., 2002; Büscher, Gill, Mogensen, & Shapiro, 2001). Therefore, they play very important roles as design, implementation, and representation tools (Farrelly, 2012).

In conclusion, the model-making process improves students’ professional abilities and skills and facilitates learning alongside the discussion experience provided for the student or the designer on the level of reality, as well as their contribution to the design process. The basic knowledge and skills that determine the limits of the conceptualization and visualization of a student or designer are the attributes that make him/her a designer. Model making, which develops this knowledge and these skills, is an important design and learning method. The modeling technique creates a multi-disciplinary and contemporary design and production platform. In addition, it is possible to draw the conclusion that model making and utilization could be used as a productive design, creation, and delivery method for numerous other disciplines and courses.

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Peyzaj Mimarlığı Eğitiminde Maket Yapımının Tasarım ve Öğrenmeye Etkileri

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Özet

Problem Durumu: Peyzaj mimarlığı, mimarlık, iç mimarlık vb. tasarım disiplinlerinin eğitiminde kullanılan modelleme metodlarından biri maket yapımıdır. Öğrencilerin hayal ettikleri ve tasarladıkları ürünlerin gerçeğe uygun olup olmadığını görebilmeleri için maket yapımı önemli bir araçtır. Öğrencinin yapması gereken ilk adım, zihninde oluşan fikirleri; kağıt, kalem veya maket gibi somut araçlar kullanarak görselleştirmektir. Gerçeği yansıtması açısından maket bu açıdan oldukça etkili ve faydalıdır. Bu açıdan bakıldığında maket; zihindeki soyut düşünce ile gerçek arasındaki ilişkiyi kuran bir anlatım tekniğidir ve gerçek somut bir ürün olarak ortaya çıkar. Maket aracılığıyla tasarımda anlatılmak istenen tüm detaylar somut ve gerçekçi olarak ifade edilebilir. Perspektif çizimler tek ya da birkaç bakış açısı sunarken, makete her açıdan bakılabilir, etrafında hareket edilerek her açısı değerlendirilebilir. Bu nedenle maket anlatım tekniğinin; tasarım ve öğrenme üzerindeki etkisini anlayabilmek için bu çalışmada maket olgusu araştırılarak, maket yapımı ve kullanımının öğrenime pozitif etkilerine vurgu yapılmıştır.

Araştırmanın Amacı: Günümüzde oturma donatıları insanların yaşamlarının bir parçası haline gelmiş, en yoğun kullanılan donatı türüdür. Bu nedenle peyzaj mimarlığı öğrencileri için kentsel açık mekânlarda da en çok kullanılan donatı yani oturma birimi tasarım sürecini öğrenmek önemlidir. Oturma etkinliğinin gerçekleşeceği yüzey farklılaşsa da mutlaka uygun antropometrik ölçülere ve ergonomik koşullara sahip olmalıdır.

Tasarımcıya düşen ilk olarak ergonomik, ikinci olarak da özgün, yaratıcı oturma birimleri tasarlamaktır. Peyzaj mimarları; insanların ihtiyaç ve istekleri doğrultusunda çevrenin tasarlanmasıyla kullanıcılara yaşanabilir mekânlar yaratır. Peyzaj mimarlığı disiplini bu mekânları tasarlarırken öncelikle kullanıcı ihtiyaçlarını karşılayan, ergonomik işlevsel tasarımlar sonra da yaratıcılığı üst düzeyde estetik-özgün tasarımlar ön plana çıkmalıdır. Bu nedenle bu ders, öğrencilere uygun etkinlik için uygun ölçü, malzeme, biçime sahip yaratıcı donatı tasarımı geliştirme anlayışını kazandırmayı amaçlar. Bu çalışmanın uygulama kısmında; Karadeniz Teknik Üniversitesi Peyzaj Mimarlığı Bölümü eğitiminde 3. Yarıyılında verilen "Donatı Tasarımı" dersi ele alınmıştır. Dersi alan 30 öğrenciden oturma etkinliği için maket üzerinde 1/20 ölçeğinde donatı tasarımları istenir. Amaç oturma donatısını uygun ölçü ve özgün biçimde nasıl tasarlanabileceğinin öğrenciye kavratılmasıdır. Bu ders öğrencilere; ergonomik ve estetik açıdan donatıların tasarım sürecinde nasıl kullanılacağını öğretmeyi amaçlayan seçmeli bir derstir. Seçilen etkinlik ile bütünleşen, uygun ölçü ve biçimde yaratıcı donatılar tasarlanması dersin hedefini oluşturur. Ders kapsamında öğrencilere oturma etkinliği verilmiş ve özgün bir oturma donatısı tasarımları bunu da maketle ifade etmeleri istenmiştir.

Araştırmanın Yöntemi: Bu çalışmada materyal olarak, KTÜ Peyzaj Mimarlığı Bölümü 2.sınıf derslerinden "Donatı Tasarımı" dersinde öğrencilerin oturma etkinliği için tasarladığı 1/20 ölçekli oturma birimi maketleri kullanılmıştır. Bu dersin kapsamındaki eğitim yaklaşımı, biçimsel ve işlevsel bütünlüğün sağlanması üzerine odaklanır. Öğrencilerden seçilen oturma etkinliğine bağlı olarak yorumlama yapıp doğru ölçü ve biçimde özgün oturma birimi tasarımları ve bunu maketle ifade etmeleri beklenir. İlk aşamada; ders kapsamında öğrencilerin oturma etkinliğini maket üzerinde nasıl analiz ettikleri, tasarımlarında ölçü, biçim ve donatı ilişkisini nasıl yorumladıkları açıklanmaya çalışılmış, donatı maketleri bu amaçla incelenmiştir. İkinci aşamada ise anket çalışması yapılmış; maket tekniğinin öğrencilerin tasarım sürecine ve öğrenmelerine etkileri sorgulanmıştır. Anket iki kısımdan oluşmuştur; ilk kısımda maket yapımının tasarım sürecine yönelik, ikinci kısımda ise öğrenmelerine yönelik etkileri sorgulanmıştır. Ankette 5' li skala verilerek puanlama yapmaları istenmiştir, Maket yapımının tasarım süreçlerine katkılarının neler olduğu belirlemeye yönelik olarak; maket yapımı biçimsel açıdan ne kadar faydalıdır, (maket yapımı) işlevsel açıdan ne kadar faydalıdır, (maket yapımı) gerçekçilik açısından ne kadar faydalıdır, (maket yapımı) yaratıcılık açısından ne kadar faydalıdır soruları sorulmuştur. Böylece donatı tasarımı dersinde maket tekniğinin öğretim düzeyi belirlenmeye çalışılmıştır.

Araştırmanın Bulguları: Maket yapımı tasarım sürecine; yaratıcılığı geliştirmesi ve gerçekçiliği ifade etmesi açısından çok iyi derecede fayda sağlamıştır. "Biçimsellik" ve

“işlevsellik” açısından da sürece iyi derecede yardımcı olmuştur. Öğrenciler maket yaparken; donatının biçime, malzeme-biçim ilişkisini çok iyi derecede, donatı tasarımında ölçü-biçim ilişkisini, malzeme ve ölçüyü de iyi derecede öğrenmişlerdir.

Araştırmanın Sonuçları ve Öneriler: “Donatı tasarımı” dersi kapsamında; maket yapmanın özellikle “yaratıcılık” ve “gerçekçilik” açısından öğrencilerin tasarım süreçlerine katkı sağladığı belirlenmiştir. Ayrıca uygulanan maket yöntemi; tasarım öğrencilerine estetik, işlevsel ve biçimsel açıdan yardımcı olmuş, donatı tasarımı sürecini daha anlaşılabilir hale getirmiştir. Maket yapma yaklaşımı, öğrencilerin tasarım süreçlerinin gelişimine önemli katkı sağlarken aynı zamanda öğrenme süreçlerine de ölçü, biçim, ölçü-biçim ilişkisi, malzeme, malzeme-biçim ilişkisini anlamaları açısından da çok yardımcı olmuştur. Ayrıca bu çalışmaya bağlı olarak, maket yapımı ve kullanımının, potansiyel başka birçok disiplin ve ders için de tasarlamaya yardımcı, seçenek üretme için geçerli bir anlatım tekniği olarak kullanılabilceği sonucuna varılabilir.

Sonuçta öğrencilerin maket yaparken tasarım anlayışlarının geliştiği ve oturma birimi maketi yapımının ölçü, biçim, malzeme açısından peyzaj mimarlığı öğrencileri için öğretici bir yöntem olduğu belirlenmiştir.

Anahtar Sözcükler: Yaratıcılık-gerçeklik, eğitim modeli, donatı tasarımı, öğrenme.