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The Most Suitable Office Chair Alternative For Drafting Studios: The Sample of Bartın University Landscape Architecture Department

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Research Article

Abstract − In today's drafting areas the design of interior elements in line with ergonomical criteria holds great importance from physiological and psychological aspects. Especially the chairs and desks, used by the students who spend most of their times in schools, should be designed in line with ergonomical criteria. In this study, a survey study was carried out with undergraduate students of Bartin University Landscape Architecture Department to determine their demands and requests on the issue. The AHP (Analytic Hierarchy Process) model was built in accordance with the user demands and requests, and accordingly the main and sub-factors of the model were determined as a means to make the most suitable chair selection for use in draft studios. According to the outcomes of AHP model, ergonomy (77%), economy (16%) and aesthetics (7%) were found to be the main effective factors in chair selection. Also, the chairs with adjustment function, armrest and lumbar support were determined as the most suitable ones for use in draft areas. In the results section of the study, the most suitable chair features for use in draft rooms, as well as suggestions for future studies are proposed.

Keywords − *Analytic Hierarchy Process (AHP), ergonomy, furniture industry, draft area, drawing chair.*

Çizim Stüdyolari İçin En Uygun Koltuk Seçimi: Bartın Üniversitesi Peyzaj Mimarlığı Örneği

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Araştırma Makalesi

Öz− Günümüzde kullanılan mekan ve mekan donatı elemanlarını ergonomik kriterlere göre tasarlanması fizyolojik konfor ve psikolojik açıdan önem arz etmektedir. Özellikle zamanlarının büyük bir kısmını okullarda geçiren öğrencilerin kullandıkları koltuk ve masaların ergonomik kriterlere uygun olması gerekmektedir. Bu çalışmada Bartın Üniversitesi Peyzaj Mimarlığı Bölümü öğrencilerine anket çalışması yapılarak talep ve istekleri belirlenmiştir. Belirlenen kullanıcı talep ve isteklere göre AHS (Analitik Hiyerarşi Süreci) modeli kurulmuş, modele ait ana ve alt faktörler oluşturularak çizim stüdyolarında kullanılacak en uygun koltuk seçiminin yapılması hedeflenmiştir. AHS modeli sonucunda koltuk seçiminde ergonomikliğin (% 77), ekonomikliğin (%16) ve estetiği (%7) koltuk seçiminde etkili ana faktörlerden olduğu belirlenmiştir. Ayrıca farklı yönlerde ayarlanabilen, kolçaklı ve bel destekli koltukların çizim mekanlarında kullanılacak en uygun koltuk özellikleri olarak tespit edilmiştir. Çalışma sonunda çizim mekanları için kullanılabilecek en uygun koltuk özellikleri ortaya konulmuş ve gelecekte yapılacak çalışmalar için ait öneriler geliştirilmiştir.

Anahtar Kelimeler − *Analitik Hiyerarşi Süreci (AHS), ergonomi, mobilya endüstrisi, çizim mekani, çizim koltuğu*

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1. Introduction

The idea of applying ergonomical arrangements on all interior and exterior elements of living spaces, have become a necessity as the mankind strives to render its living area a more habitable place. (Yıldırım and Kasal, 2005; Kaygın and Demir, 2017; Cengiz et al., 2018). Ergonomy is known as a professional discipline using theories, principles, data and methods to maximize the well-being of mankind and optimize the performance of overall system (Dul and Weerdmeesder, 2003; Aşkin et al., 2021). People take various actions in line with their biological, social, psychological and physical features and needs. In general, they need interior and exterior elements to carry out these actions. (Yıldırım and Kasal, 2005). All products, intended for outdoor or indoor use, must be designed in accordance with the anthropometric measures of physical structure of humans. (Harris and Straker, 2000; Akın, 2012; Kaya, 2015; Pheasant and Haslegrave, 2018; Cengiz et al., 2018).

Undeniably, the design of the spaces with different functions (home, working environment, school, vehicle, street, etc.) as well as the design of interior and exterior elements used in these spaces, have great impacts on physical and mental health, efficiency, and economic welfare of people (Hastürk, 2013). Draft rooms are widely used in commercial enterprises in which various products are manufactured, as well as vocational and technical educational institutions in which several teachers and students receive their education. (Yıldırım and Kasal, 2005). Long working hours spent in wrong sitting positions on the interior elements (desks, chairs) which do not meet ergonomical design rules and standards in such working places and design schools, increase the risk of health problems such as neck, back, lumbar and hip pain (Linton et al., 1994; Knight and Noyes, 1999; Hedge and Lueder, 2008; Kahya et al., 2011; Dianat et al., 2013; Akın et al., 2014; Odunaiya et al., 2014; Ertaş et al., 2015; Saes et al., 2015; Souza et al., 2015). Seat elements (arm-chair, chair etc.) have an important place in people's life. Today, most of the people spend their time working and generally on their computer. Therefore, office chairs could be regarded as an extension of modern human's body, which has negative implications for people's health and reduces their efficiency and motivation.

Working at an elevated desk in draft studios results in weariness, neck and shoulder pain, especially for stoop shouldered people (Grandjean and Burandt, 1962; Schoberth, 1962; Yıldırım and Kasal, 2005). Users have both aesthetical and functional expectations from the chairs in working environments. The seat element should adapt to the human anathomy during long working hours. Therefore, making the most suitable chair selection in line with the needs and demands of the users is essential.

In this study, a questionnaire was conducted on the undergraduate students of Landscape Architecture Department, spending long hours in draft studios, to determine the level of discomfort and pain in various parts of their body. The criteria for compliance of seat elements (seat, chair, etc.) to demands and requests of users, were determined according to the results of the questionnaire. The determined factors were modeled using Analytical Hierarchy Process (AHP) and accordingly the most suitable chair was selected. The most suitable chair features for use in draft areas are proposed in the results section of the study.

2. Material and Method

2.1. Office Chairs

Tablo 1
General features of the office chairs

Features	**C_1**	**C_2**	**C_3**	**C_4**
Arm-rest	Without armrest	Without armrest	Without armrest	Without armrest
Upholstery	Fabric	Leather	Fabric	Fabric
Adjustability	Single Direction	Single Direction	Three Directions	Two Directions
Mechanism	Moving	Moving	Moving	Moving

Four different office chairs were selected among the ones put up for sale by State Supply Office (DMO) in consideration of the demands and requests of the users participating in the survey study. C1, C2, C3, C4, represent the office chairs, and the features of the office chairs are given in Table 1.

2.2. Survey Study

The survey study was carried out to determine the level of discomfort and disorders that students undergo in draft areas during their study, as well as their demands and requests in the working place. In this regard, the questionnaire was carried out with 1st, 2nd, 3rd and 4th grade students of Bartin University, Landscape Architecture Department. In the questionnaire, the feelings were rated in likert scale as 5 levels between ''very uncomfortable'' and ''very comfortable'' to observe the change of feelings in some of the main body parts (neck, lumbar, back, hip, knee, foot, etc.) of the students, depending on drafting-drawing duration. The sample size required for the conducted survey study was evaluated using Equation (2.1) (Naing et al., 2006; Kılıç, 2012; Kaygın et al., 2015).

$$n = \frac{N.t^2(p.q)}{d^2(N-1) + t^2(p.q)} \tag{2.1}$$

Here,
N = Number of individuals in the universe (this value is 110 in this study),
n = Number of individuals included in the sample,
p = Incidence rate of observed incident (probability),
q = Nonoccurrence rate of observed incident $(1 - p)$,
t = The theoretical value found in table t by specific degree of freedom and determined error level,
d = $+$ deviation intended depending on the incidence rate of incident.

It was determined by Equation (2.1) that 79 students were required for the survey study being conducted. The conducted questionnaires were evaluated using frequency analysis, and demands, requests and discontent of the participants were determined accordingly.

2.3. Analytical Hierarchy Process

As consideration of several subjective criteria beside objective criteria, is required in chair selection, Analytical Hierarchy Process was selected for solution of the present problem. Effective factors were determined by percentage and frequency data in the conducted survey study. Checking the consistency of the comparison between each criteria is the most important factor affecting the validity of the obtained result. Therefore, consistency of relation matrices should be ensured. The consistency ratio (CO), developed by Saaty (2000), is found using Equation (2.2). CI: Consistency Index is calculated by Equation (2.3) and RCI: Rassal Consistency Index is calculated by Equation (2.4).

$$CO = \frac{CI}{RCI} \tag{2.2}$$

$$CI = \frac{\lambda_{max} - n}{(n-1)} \tag{2.3}$$

$$RCI = 1.98 \cdot (n-2) \tag{2.4}$$

Consistency ratio (Equation (2.5)) is obtained by putting Equation (2.3) and (2.4) in Equation (2.2).

$$CO = \frac{\left[\frac{\lambda_{max} - n}{n-1}\right]}{1.98 \cdot (n-2)} \quad (2.5)$$

The comparison matrix can be regarded consistent if the consistency ratio obtained using Equation (2.5) is under 0.1. (Saaty, 2000). The final stage of Analytical Hierarchy Process in this procedure is to find the product of importance weights of criteria and alternatives, and to determine the priority value for each alternative. Consequently, the alternative with the highest value is the best alternative for the problem (Toksarı, 2007; Imren et al., 2016; Imren et al., 2017; Kurt, 2020).

3. Findings And Discussion

According to Grandjean and Burandt (1962); and Schoberth (1962),weariness, neck and shoulder pain were reported by stoop shouldered individuals sitting around an elevated table. Health problems such as neck, back, lumbar and hip pain occured after long working hours spent by students in wrong sitting positions on the interior elements (desks, chairs) which do not meet ergonomical design rules and standards, (Linton et al., 1994; Knight and Noyes, 1999; Hedge and Lueder, 2008; Dianat et al., 2013; Akın et al., 2014; Odunaiya et al., 2014; Saes et al., 2015; Souza et al., 2015).In the conducted questionnaire, respectively 34%, 40% and 54.1% of students reported neck, lumbar and arm pain and 28.2% of students reported that the office chair was very uncomfortable. One of the main factors was determined as ergonomy in the conducted survey study. Economy and style were used as the other factors within the scope of user demands (Figure 1).

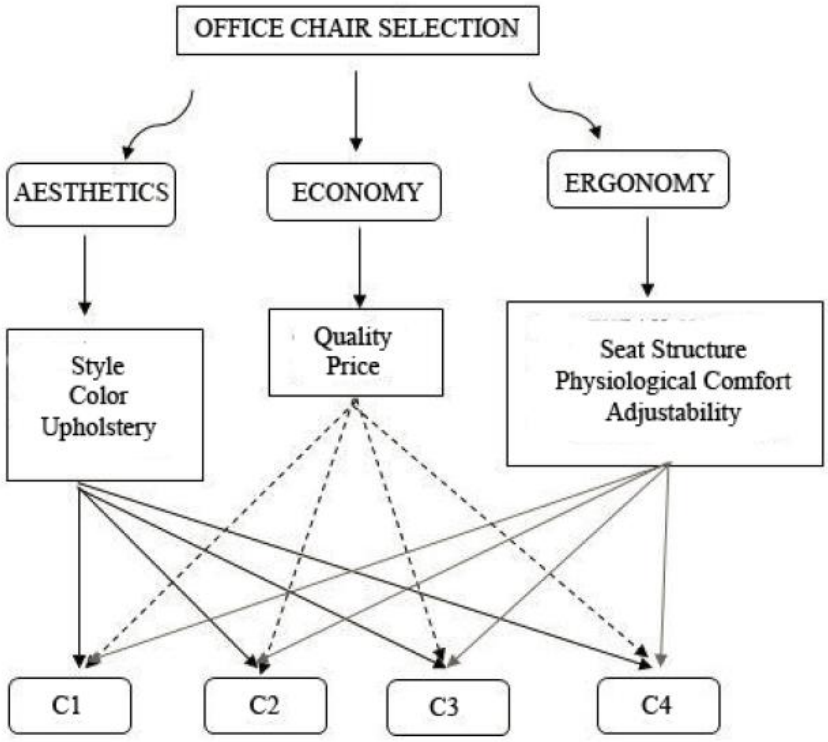

Figure 1. Office chair hierarchy model

The importance of aesthetics (Table 2) in chair selection comes into prominence by C3 with style (62%) and upholstery (47%) sub-criteria, and by C1 with color (36%) sub-criterion. Also upholstery material as a sub-criterion of aesthetics, was determined to be effective (74%) in chair selection. Alternative C3 was found as the most suitable product in terms of aesthetics.

Table 2
Weights of aesthetic criterion's sub-criteria by each alternative.

AESTHETICS / ALTERNATIVES	Style	Color	Uphols.	W
C_1	0.058	0.358	0.199	0.214
C_2	0.242	0.110	0.137	0.142
C_3	0.624	0.230	0.465	0.439
C_4	0.076	0.302	0.199	0.206
W	0.119	0.134	0.747	

The importance of economy (Table 3) in chair selection comes into prominence by C3 with quality (64%) and by C4 with color (36%) sub-criterion. Also quality as a sub-criterion of economy, was determined to be effective (44%) in chair selection. Alternative C3 was found as the most suitable product in terms of economy.

Table 3
Weights of economy criterion's sub-criteria by each alternative

ECONOMY / ALTERNATIVES	Quality	Price	W
C_1	0.059	0.306	0.110
C_2	0.191	0.127	0.178
C_3	0.647	0.065	0.528
C_4	0.103	0.502	0.185
W	0.833	0.167	

The importance of ergonomy (Table 4) in chair selection comes into prominence by C3 with seat structure (56%) and physiological comfort (65%) sub-criteria, and by alternatives C3 and C2 with adjustability (43%) sub-criterion. Also physiological comfort, as a sub-criterion of ergonomy, was determined to be effective (83%) in chair selection. Alternative C3 was found as the most suitable product in terms of ergonomy. Tunay vd. (2005) reported that the spaces, elements and equipments arranged in line with ergonomical standards positively contributes to the physical and mental development of students. According to the results obtained in a vast number of studies, researchers agree on the importance of using school furnitures with sizes and ergonomical designs that comply to the anthropometric body structures of students. (Brewer et al., 2009; Castellucci et al., 2010; Ramadan, 2011; Dianat et al., 2013; Feathers et al., 2013).

Table 4
Weights of ergonomy criterion's sub-criteria by each alternative

ERGONOMY / ALTERNATIVES	Seat Structure	Physiological Comfort	Adjustability	W
C1	0.095	0.076	0.079	0.079
C2	0.249	0.191	0.427	0.325
C3	0.560	0.657	0.427	0.524
C4	0.095	0.076	0.067	0.072
W	0.059	0.490	0.451	

The performance graph based on the built AHP model, is given in Figure 2. According to the performance graph the most suitable alternative in terms of aesthetics, economy and ergonomy, is determined as C3 (52%). Also, according the performance graph, alternative C2 was found suitable by 29%, C4 by 10% and C1 by 8%.

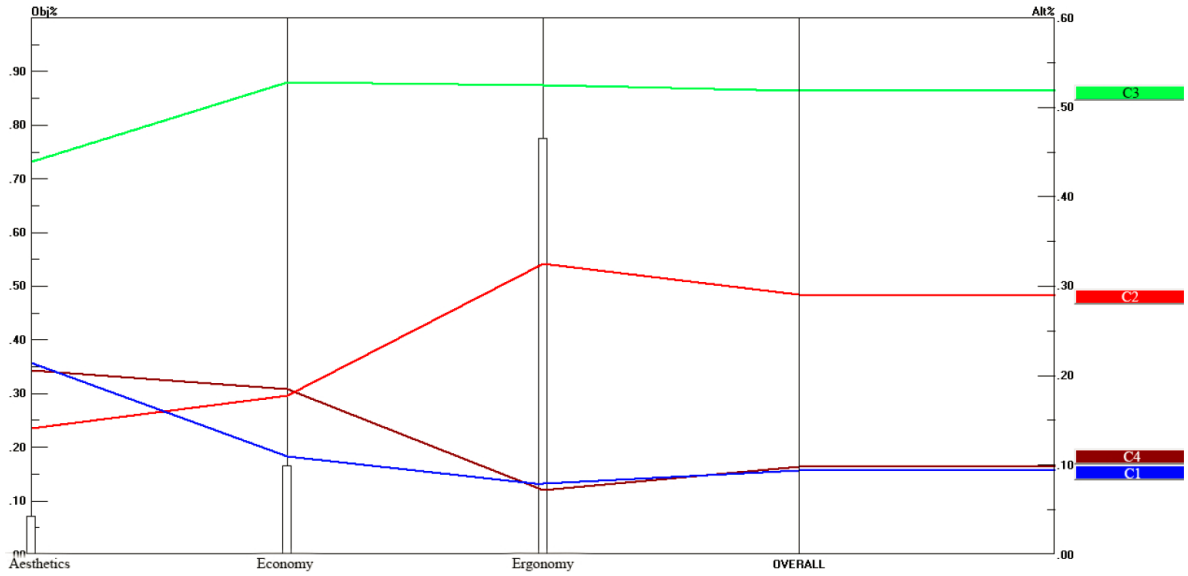

Figure 2. Performance graph of the chairs

The decision matrix of the built AHP model is given in Table 5.

Table 5
AHP model decision matrix

CRITERIA / ALTERNATIVES	Aesthetics	Economy	Ergonomy	W
C1	0.214	0.110	0.079	0.094
C2	0.142	0.178	0.325	0.290
C3	0.439	0.528	0.524	0.518
C4	0.206	0.185	0.072	0.098
W	0.068	0.162	0.770	

4. Conclusion

According to the results of conducted questionnaire and the decision matrix (Table 5) of the built AHP model, ergonomy is the most effective factor by 77% in chair selection of users. The office chairs with adjustment feature in 3 directions, arm-rest and lumbar support were found to meet the demands and requests of users. Also, economy and aesthetics were found to be effective by 16% and 7% respectively, in chair selection. The ergonomical analyses drawing on anthropometric measurement of users and digital human models, and the chairs designed in accordance with the results of these analyses, will pave the way for future studies

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