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Article

Relating environmental comfort conditions to student satisfaction with remote learning: A case on design students

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ABSTRACT

Remote learning applications have crucial importance in preventing education processes from being interrupted under extreme conditions such as a pandemic. Numerous studies on the field are being performed, as it is thought that remote learning will become even more critical in time. Notably, the variety of built environments in different regional, social, cultural, and technological aspects encourages researchers to investigate such differences and student performance and satisfaction relating to their conditions. Focusing on design students, who may have more distinct requirements since the nature of the education program they are subject to, this article aims to present the comfort conditions of students, as well as the relationship of such conditions with the level of student satisfaction with remote learning. The method of this study includes a comprehensive survey, which has been delivered to architecture and interior architecture students via online channels, questioning their spatial, visual, auditory, and thermal comfort. The multiple regression analysis, which has been used in connecting comfort conditions and satisfaction, has resulted that the built environment has a slight yet significant effect on satisfaction level (R=0.374). This result is substantial considering the variety and complexity of factors affecting satisfaction with remote learning. Findings of this study include that visual comfort conditions are the most influential on student satisfaction, indicating the inference that improvements relating to these conditions will be quite effective. The results of this study provide a perspective for improving remote learning processes and adapting living environments to remote learning, based on different student groups.

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INTRODUCTION

Having affected 90% of the student population of the world (Unesco, 2020) the Covid-19 pandemic has led many countries to suspend face-to-face education and put compulsory remote learning processes into practice. Various researches have focused on remote learning, especially from 2006 and onwards, which was the subject of research before the Covid-19 epidemic (Salama & Wilkinson, 2017; Sun & Chen, 2016). The research of Allen and Seaman (2013) reveals that the global financial crisis in

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2008 had also been a driving factor for the improvement of remote learning. Several countries around the world have synchronously experienced a switch in education processes by necessity (Boca, 2021; Ibrahim et al., 2021; V.-H. Lee et al., 2021; Muthuprasad et al., 2021; Tleuken et al., 2022; D. Yang & Mak, 2020), to such a point that it can be inferred that the Covid-19 pandemic constitutes a breaking point in research and improvements in the field of remote learning.

Researches which have been initiated with Covid-19 pandemic (Arifiati et al., 2020; Boca, 2021; Jiang et al., 2021; V.-H. Lee et al., 2021; Muthuprasad et al., 2021; Oskaloğlu & Çatı, 2021; Özçiftçi, 2021; Tleuken et al., 2022) have focused on the effect of remote learning under compulsory situations. The factor of satisfaction, which has a substantial part in student motivation in terms of studying and learning, has been increasingly examined both before (Vilcekova et al., 2017; Z. Yang et al., 2013) and during the Covid-19 pandemic period. The increasing number of field researches and empirical studies focusing on this field indicates that remote learning will retain its important role in education processes.

Studies on student satisfaction with remote learning mainly focus on the psychological and psycho-social perceptions of students (Arifiati et al., 2020; Boca, 2021; Jiang et al., 2021; V.-H. Lee et al., 2021; Muthuprasad et al., 2021), while very few of the researches (Oskaloğlu & Çatı, 2021; Tleuken et al., 2022) have discoursed the effects related to the physical environment. In these researches, higher education students have been evaluated independently of their field of study. Teaching architecture in an online format is rare due to the nature of the discipline and student-instructor interaction (Ibrahim et al., 2021). Since design studio courses are involved in the course program, students of fields such as architecture and interior architecture have distinct and unique requirements (Karassowitsch, 2019). On the contrary of researchers who assert that online studio courses will not be able to substitute traditional studio courses (Salama & Wilkinson, 2017; Silva & Lima, 2008), Saghafi et al. (2012) propose a blended design studio that provides a combination of physical studio and virtual environment.

Teaching and learning strategies in design fields have drawn great interest due to their significance in the education of qualified architects and interior architects. Therefore, this study focuses on design students studying in the fields of architecture and interior architecture. The value of this research is based on the assessment of the relationship between environmental comfort factors and student satisfaction within the concept of remote learning, which lacks research on remote learning strategies in an adaptation of studio and design courses (Ibrahim et al., 2021) and psycho-social perceptions of students (Alnusairat et al., 2021).

Insufficient environmental comfort can have a substantial effect on the learning capacity of students (Haverinen-Shaughnessy et al., 2015). It has been widely recognized that a comfortable environment increases working productivity (M. C. Lee et al., 2012; Rosa-Jimenez & Jaime-Segura, 2021; Toyinbo et al., 2016), as this concept can be extended to the productivity level of students (Ricciardi & Buratti, 2018).

Environmental comfort is established through some factors like anthropometry, climate, sound, vibrations, light, and smell (Bouwens et al., 2018). Frontczak and Wargocki (2011) discuss thermal, visual, auditory, and spatial conditions. Nevertheless, rather than being solely based on objective parameters, environmental comfort is dependent on several factors which require detailed research in various fields (Ricciardi & Buratti, 2018).

In the literature review, it is seen that environmental comfort conditions are effective in education and learning. The general purpose of the research is how this situation will affect remote learning. The research problem is shaped in the context of design students and their differing needs from other students, which are one of the limits of the study. Accordingly, "*whether the environmental comfort conditions of design students affect their satisfaction with distance education*" is the main problem of the research. The theory that we created based on the literature review is that environmental comfort conditions will affect satisfaction with distance education linearly. We used a quantitative method, multiple regression analysis, to test the hypothesis. We analyze the data we collect from students through the questionnaire we developed specifically for this study with the SPSS program and prove it statistically.

BACKGROUND

Remote Learning and Environmental Comfort

Comfort can be defined as the consistency between the functional, technical and perceptive performance of a building and the user expectations (Giresun Erdoğan & Polatoğlu, 2021) and the psychological satisfaction of the user which is achieved through optimal performance in user activities (Oral et al., 2004).

The process of learning and training require students to spend a long time within the same interior space. Especially design students proceed to use the same space not only during course hours but also during their processes of design and production. Therefore, environmental comfort is directly related to providing the health and prosperity of students (Bluyssen, 2017; Fantozzi & Rocca, 2020; Lamberti et al., 2020).

The insufficiency in environmental comfort conditions may result in a negative effect on the learning capacities of students and their creativity in thinking in three dimensions.

Indoor environmental conditions are associated with triggering health and learning difficulties for students in a study conducted by Soccio (2016) in a school context. The author remarks that poor indoor environmental quality can trigger health and learning difficulties for students and adversely impact the well-being of educators and their students. Lee et al. (2012) observed strong relationships between spatial comfort in interior spaces and learning performance. Similar observations were made on the effects of comfort conditions on the student's performance by some other researchers, for example, Krüger and Zannin (2004). They concluded that auditory, visual, and thermal comfort also affect stress, concentration, and disturbance, respectively.

Bouwens et al. (2018) rank the environmental comfort factors from most important to least important: anthropometry, climate, noise, vibrations, light, and smell. Similarly, Tleuken et al. (2022) makes a definition like this without a hierarchy; light, a robust supply of electricity and internet, noise, technical resources, personal study space, and temperature and humidity. However, rather than being only an objective concept, human comfort is dependent on various factors and subfactors (Ricciardi & Buratti, 2018). Although conditions of built interior spaces have been examined within thermal, auditory, and visual aspects (Frontczak & Wargocki, 2011; Krüger & Zannin, 2004; Oral et al., 2004), an investigation regarding the spatial sufficiency of students is also required due to the obligatory and unprovided nature of the switch to remote learning.

Soccio (2016) relates the conditions that affect education and training as environmental, motivational, socio-economic & socio-cultural, and pegagogical & currcular factors. We approached the environmental comfort conditions constituting the working limits, spatial requirements, and competencies, generally within their dependence on ergonomic factors. Yet, physical measurements solely lack in achieving environmental comfort (Ricciardi & Buratti, 2018). Frontczak and Wargocki (2011) have stated that providing for requirements such as privacy and personal space (Allen & Seaman, 2013) also has a remarkable effect on human comfort. It is crucial to take the psychological conditions and requirements of students into consideration in shaping the space and equipment for studying. Figure 1 shows the conceptual scheme that we have created based on this information and the factors of Soccio (2016). According to this scheme evaluating environmental comfort with perceptual data can be considered a new approach.

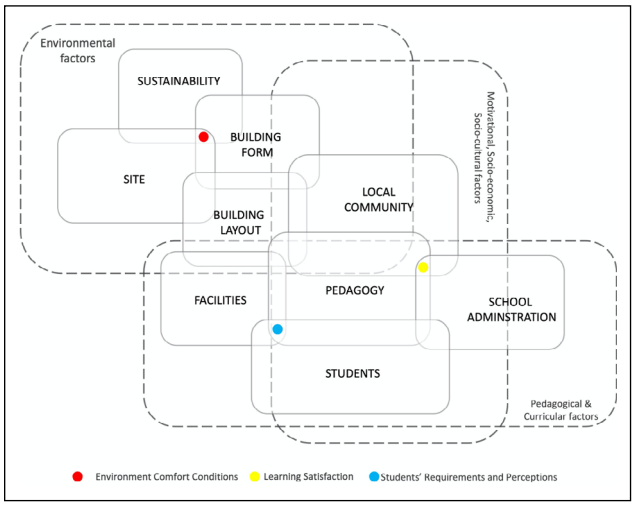

Figure 1. The relation between learning satisfaction with environmental comfort and students' perception.

Remote Learning and Satisfaction

As the success of remote learning is related to achieving student satisfaction (Jiang et al., 2021; Özçiftçi, 2021), the effect of the Covid-19 pandemic on student satisfaction with remote learning has been globally researched. A study by Aristovnik et al. (2020) has asserted that student satisfaction with remote learning during the Covid-19 pandemic has been lower in countries that have lower life standards compared to the other countries. Studies based in various countries have shown that students prefer online education during the pandemic, yet remote learning cannot substitute traditional face-to-face education (Boca, 2021; V.-H. Lee et al., 2021; Muthuprasad et al., 2021; Özçiftçi, 2021). While research-based in Jordan has emphasized the indecisiveness of students regarding their satisfaction with remote learning processes (Alnusairat et al., 2021; Ibrahim et al., 2021), Jiang et al. (2021) state a positive level of satisfaction in case of Chinese students. Also, a report by the Council of Higher Education has shown that Turkish students prefer face-to-face education (Council of Higher Education, 2021).

During remote learning processes, students become subject to more than one environmental factor. Various combinations of more than one interior environmental factor affect environmental perception (D. Yang & Mak, 2020). Categorizing perception types and determining the effect of such categories to overall perception are complicated processes (Jin et al., 2020; W. Yang & Moon, 2018, 2019). These constitute a valid base for the requirement to examine satisfaction with remote learning from various perspectives.

Yang et al. (2013) state that studies that focus on various aspects of learning environments and encourages the learning process of students started in the 1960s. According to these studies, learning environment-related perceptions of students can be categorized under three topics: "*perception of the psychosocial environment such as belongingness and connection with classmates; perception of the psychological environment such as motivation,*

self-efficacy, and achievement; and perception of the physical environment such as classroom size, lighting, and technology." In parallel, later studies have examined learning performance and satisfaction by focusing on psychosocial conditions (Alnusairat et al., 2021), psychological factors (Ibrahim et al., 2021) and conditions relating to the physical environment (Oskaloğlu & Çatı, 2021; Tleuken et al., 2022). This article distinguishes itself by analyzing the success in adapting to a different physical learning environment (transition from school to home) within the context of comfort conditions, and its relationship with satisfaction with remote learning focusing on design students.

Remote Learning in Design Fields

The basis of design education is constituted by practical courses which are conducted in special classrooms called "*studios*". Design studios provide students with a multi-dimensional and enriching learning experience. The education process in studio training is based on "*experimental learning*" or "*learning by doing*" (Nicol & Pilling, 2000). Therefore, as design education is distinguished from other undergraduate education programs by requiring creativity for design (Akin & Akin, 1996; Taneri & Dogan, 2021), design students have distinctive necessities compared to students working in other fields.

Although there had been various initiatives to digitize design education programs as online, remote processes before the Covid-19 pandemic (Saghafi, M.R., Franz, J. and Crowther, 2012; Salama & Wilkinson, 2017; Silva & Lima, 2008; Wojtowicz, 1995), researchers had reached a consensus that online education cannot substitute face-to-face training. This has led the effect of remote learning on architecture students to become a topic of discussion (Alnusairat et al., 2021; Ibrahim et al., 2021; Oskaloğlu & Çatı, 2021; Şekerci et al., 2021). As the digitization of design studios has started, students have lacked materials to present their works such as boards, drawing tables, cardboards, etc. (Alnusairat et al., 2021; Ibrahim et al., 2021). Besides, the research by Tleuken et al. (2022) had shown that students complain about their home environment not being reconciled for education and decent studying. Within this direction, this study includes spatial qualifications regarding distinct necessities of design students, alongside the factors which are examined within the context of research focusing on the comfort of students in the classroom environment (Ricciardi & Buratti, 2018; D. Yang & Mak, 2020; W. Yang & Moon, 2018; Z. Yang et al., 2013). Within the context of this article, conditions of architecture and interior architecture students such as having sufficient private space, storage spaces for design and working materials, computer tables, and ergonomically convenient chairs to use in following remote learning programs, have been examined as comfort parameters.

METHODS AND MATERIALS

The beginning of this article covers a literature review focusing on the factors affecting learning performance and education-related satisfaction of students. The study which has been conducted before the Covid-19 pandemic by Yang et al. (2013), proved that physical comfort conditions in the classroom have influential effects on learning and satisfaction. Based on that study the literature review of this article also focuses on physical comfort conditions.

This study is a case study that reveals the environmental comfort conditions of a certain student group in a certain period. The research is a descriptive study designed in a survey model and is used to detect an existing situation as it exists (Karasar, 2017). This study is valid only for the subject of study and does not aim to generalize. However, as Karasar (2017) stated, generalizability can be achieved by increasing the number of cases examined.

This study also makes use of a statistical method to indicate the impact of a wide range of comfort attributes on student satisfaction with remote learning. Figure 2 shows the steps of the developed methodology. According to these steps, we first determined various factors and subfactors to analyze the effect of comfort conditions in the housing environment on student satisfaction. However, not all of the factors coming from the literature are simple and clear for students to evaluate by themselves. As a solution, a pilot survey has been structured for students to eliminate vacillating while answering clear questions and conducted on 15 students who have also contributed to delimiting the diversity of questions.

The pilot survey, which included the concerns and suggestions relating to environmental comfort conditions,

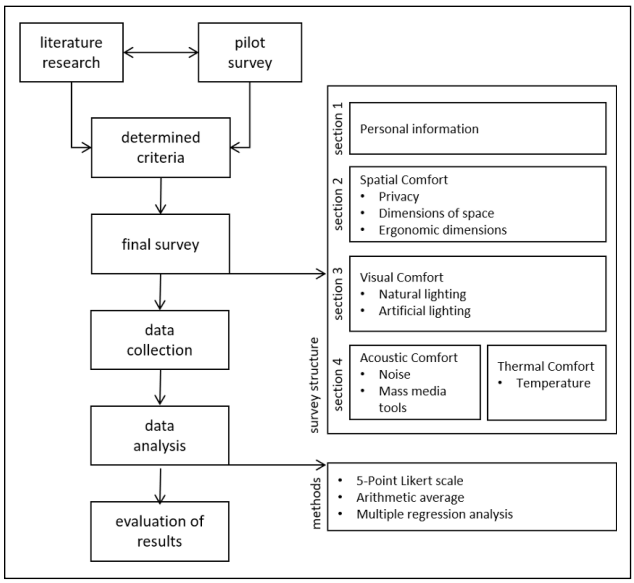

Figure 2. The structure of the research methodology.

aims to understand the potential aspects to be adapted by the satisfaction survey, as well as the problems of students. Following the feedback, simple and clear subfactors have been determined to be used by students in evaluating their studying environments. Other sub-measurements that are technically complex and require special equipment to determine, such as air quality, relative airspeed, sound level, auditory transmission, etc. have been excluded from the context of this study.

Surveys constitute important tools for analyzing physical comfort conditions (Ricciardi & Buratti, 2018). Although face-to-face interviews make room for instant feedback and clarification of certain doubts, they also require more time (Benoliel et al., 2021). Therefore, this study makes use of online surveys in order to collect more inputs in a shorter amount of time. Following the representative results of the pilot survey and the feedbacks, the updated survey has been delivered to the users.

The data obtained from students through the online systematic questionnaire have been analyzed via the SPSS program. Three techniques have been used in the analysis process: First, the findings transform qualitative verdicts into quantitative ones and obtain information on the comfort conditions of the students with the "*Likert scale*". The second technique is "*arithmetic average*". The last one is "*Multiple Regression Analysis*" (Allison, 1999). This method has been developed to relate more than one comfort condition to satisfaction with remote learning, as well as to present certain conditions and their precise effects on student satisfaction.

Survey Design

User survey provides evaluating the feasibility of comfort conditions in the home environment of students in both qualitative and quantitative manners, as well as relating the results regarding feasibility to satisfaction with remote learning.

In parallel with the goals of the survey, the approach to data collecting is based on the qualifications of the physical environment and the field that students are working in. We adopt to be understandable with quick and simple answers in survey design. For the first time, we propose the questionnaire we prepared specifically for this research to examine environmental comfort conditions from different perspectives and to obtain subjective data from students (Table 1). The most significant difference from the existing scales of this questionnaire is that it consists of questions without the need for technical measurement and technical tools that enable students to self-assess under pandemic conditions. In addition, another difference from the existing scales is that it was developed specifically for this research with the feedback from the pilot survey.

The survey has been divided into four sections to ensure students focus on one comfort parameter at a time. To determine whether an individual student is suitable for the survey, the first section covers special criteria including personal information, such as school, the field of study, age, and years spent in the program. Besides, the first section includes information on whether an individual student attended a remote learning program for at least two terms and the general satisfaction level with such program.

The second section questions the spatial sufficiencies of

Table 1. Survey Structure

Sections	Criteria	Sub-Criteria	Data
1	Personal Information	Indicators	• School, year, field
			• Regular attendance to remote learning
			• Satisfaction with remote learning
2	Spatial Comfort	Privacy	• Private/shared/co-shared working space
		Dimensions of space	• Size of working space
		Ergonomic dimensions	• Ergonomy of working desk
			• Ergonomy of working chair
3	Visual Comfort	Natural lighting	• Sufficient sunlight
			• Total window area in working space
		Artificial lighting	• Sufficient lighting fixtures
			• Artificial lighting level of working desk
4	Auditory Comfort	Noise	• Noise level
		Mass media tools	• Tv, radio, mp3 player, etc.
	Thermal Comfort	Temperature	• Evaluation for Fall term
			• Evaluation for Spring term

the students. For evaluating privacy, students have been requested to provide information on whether they have a private space for studying and, in case of lack of such space, whether they use a shared or alternate space for studying. This section assesses the sufficiency of the dimensions of the studying environment from where the student is attending to remote learning and makes perceptive evaluations, such as comfort and sufficiency of the working desk and chair, which students use for hours while studying.

The third section evaluates the visual comfort conditions of the students by assessing the ratio of window dimensions to wall surface areas, the sufficiency of lighting fixtures, and level of natural and artificial light.

The fourth section includes questions towards evaluating both auditory and thermal comfort conditions. In terms of auditory comfort, the survey aims to qualify the level of noise with qualitative expressions such as "*quite noisy*" or "*quiet*", for students who naturally lack technical equipment to measure the sound level. Besides, students have been requested to evaluate the sound of mass media tools in their working space, if any, of their own accord or not, with expressions such as "*distracting*", "*contributes* in *focusing*", etc. Students with no mass media tools (music, television, radio, etc.) in their working environment have been excluded from this question.

As the effective thermal comfort conditions are expected to differ during different seasons, the students have been requested to make qualitative assessments for fall and spring terms with expressions such as "*very cold*", "cool" or "*muggy*". All answers have been grouped into five options.

Respondent Characteristics

Having been conducted in Turkey, the survey covers undergraduate students from fields of architecture and interior architecture of various universities located in Istanbul. In order to participate in the survey, the students have been required to have regularly attended online lessons within remote learning for at least two terms (fall and spring). Answers from students who do not meet these criteria have been sorted out from the dataset.

The self-administered survey has been prepared and shared with online student groups, and then collected online. Among approximately 170 students who have participated in the survey, 110 students have been evaluated for data analysis. While 38.1% of the participating students are studying in public universities, the ratio of students studying in private universities is 61.9%. 46% of the participating students study in the field of Architecture, while 54% of them study Interior Architecture. The ratio of students registered in the program for 1, 2, 3, and 4 or more years is 40.0%, 29.1%, 18.2 and 11.8%, respectively. In terms of gender, the female/male ratio of respondent students is 57% to 43%.

Analysis of Data

Descriptive Analysis

The data collected through the online questionnaire has been analyzed through the SPSS program. As the data included qualitative assessments, the reliability of the survey questions has been tested through Alpha (Cronbach) Reliability Analysis (Cronbach, 1951).

The comfort conditions of the students have been evaluated through the questions corresponding to the subcriteria of the survey. The survey which aims to evaluate the subcriteria makes use of the 5-Point Likert scale. According to the scale, values of "5", "4", "3", "2" and "1" correspond to "*quite sufficient*", "*sufficient*", "*neither sufficient nor insufficient*", "*insufficient*" and "*quite insufficient*", respectively. In interpreting the weighted average of the answers, this study makes use of the "*Gap width = Serie width / Group count*" formula (Oral Erbaş, 2018) and determines the score intervals as 4/5 = 0.80. According to this value, structured score intervals are presented in Table 2.

The arithmetic average obtained from the subcriteria provides a basis for the quantitative assessment of the comfort conditions. Evaluation of comfort condition ($\bar{X}$) requires averaging evaluations (x) of subcriteria which are N in number (Formula 1).

$$\bar{X}=\frac{\sum_{i=1}^{n} Xi}{N}=\frac{x1+x2+\cdots+xn}{N} \quad (1)$$

Following this operation for each comfort condition, the visual, spatial, auditory, and thermal comfort of the students have been evaluated and interpreted according to the intervals given in Table 2.

Multiple Regression Analysis

Multiple Regression Analysis is a method that has been used for measuring the relationship between more than one independent variable (possible factors) and a dependent variable (possible outcome) (Allison, 1999). Required reliability and consistency tests have been conducted before the analysis. Formula 2 demonstrates a linear relationship between a dependent variable Y and two or more independent variables (x1, x2, x3 . . . , xk).

$$\boldsymbol{Y} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k \quad (2)$$

In the formula given above, Y represents the dependent

Table 2. Evaluation table

Score	Evaluation	Interval
1	Quite insufficient	1,00-1,80
2	Insufficient	1,80-2,60
3	Neither sufficient nor insufficient	2,60-3,40
4	Sufficient	3,40-4,20
5	Quite sufficient	4,20-5,00

variable, while the X1,… ,Xk corresponds to the independent variables. α and β parameters (unknown parameters) have been used in weight calculation. The multiple regression model of this study consists of four independent variables. In the model, the dependent variable (Y) corresponds to the level of student satisfaction with remote learning, while independent variables represent spatial comfort conditions (X1), visual comfort conditions (X2), and auditory comfort conditions (X3), and thermal comfort conditions (X4). The weight of effect for all subcriteria has been accepted as equal within the context of this study. Figure 3 demonstrates the regression relationship of the subcriteria.

RESULTS

Descriptive Findings

Reliability analysis, regarding the answers of students on level of satisfaction for remote learning and comfort conditions, has demonstrated that the scale is quite reliable (α=0,758) (Table 3).

The arithmetic average of the values corresponding to the answers regarding the comfort subcriteria has been calculated ($\bar{X}$) to evaluate the general state of comfort conditions. Values regarding the number of answers (valid), missing data (miss.), averages ($\bar{X}$), and standard deviation (σ) have been demonstrated in Table 4.

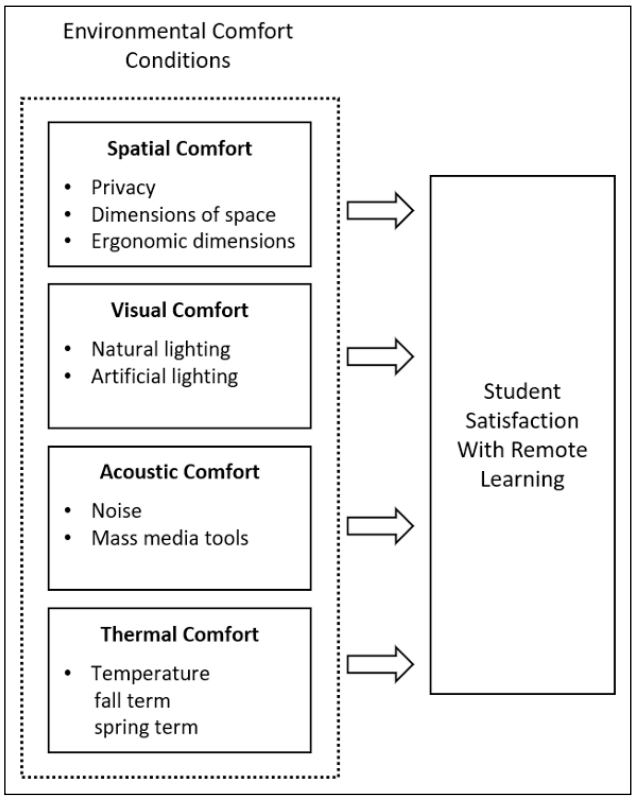

Figure 3. Conceptual framework of the multiple regression.

Table 3. Reliability analysis

Reliability Statistics		
Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**N of Items**
.758	.776	17

Table 4. Descriptive findings regarding sub-criteria

Criteria	N		$\bar{X}$	σ
	Valid	Miss.		
Privacy	110	0	4,45	1,00
Dimensions of Space	110	0	2,94	1,15
Ergonomy of Fittings 1	110	0	3,24	1,24
Ergonomy of Fittings 2	110	0	3,44	1,10
Window Dimensions	110	0	2,92	1,18
Natural Light	110	0	3,64	0,89
Lighting Fittings	110	0	3,18	1,12
Artificial Light	110	0	2,10	0,56
Noise	110	0	2,91	0,96
Mass Media Tools	97	13	2,54	1,09
Temperature (Spring)	110	0	2,71	1,09
Temperature (Fall)	110	0	3,62	1,06

Findings related to spatial comfort have proven that privacy ($\bar{X}$=4,45) of participating students is quite sufficient where a majority of participants study in a private working space. Dimensions of working space ($\bar{X}$=2,94) have been expressed as "*neither sufficient nor insufficient*". Ergonomy of fitting 1 ($\bar{X}$ =3,24), which corresponds to dimensions of the working desk, has been defined as "*neither sufficient nor insufficient*", while ergonomy of fitting 2 (dimensions, height, and comfort of the working chair) ($\bar{X}$=3,44) has been expressed as "*sufficient*".

In terms of visual comfort, window dimensions ($\bar{X}$=2,92), have been defined as "*neither sufficient nor insufficient*" when comparing the window area to the base area. The level of natural light ($\bar{X}$=3,64), on the other hand, has been stated as "*sufficient*". While lighting fittings in the studying environment have been expressed as "*neither sufficient nor insufficient*" ($\bar{X}$=3,18) in terms of count and quality, the artificial lighting level of the space has been found as "*insufficient*" ($\bar{X}$=2,10).

By means of auditory comfort, the noise in the studying space has been stated as "*neither sufficient nor insufficient*" ($\bar{X}$=2,91). A certain number of students have noted that noisy media devices exist in their studying environment and evaluated such devices as "*distracting*", which corresponds to "*insufficient*" ($\bar{X}$=2,54).

Thermal comfort findings, obtained from students' evaluation of the disturbance level of the temperature of

the studying environment, have been collected separately during spring and fall terms. According to the evaluation, room temperature has been found to not affect satisfaction during the spring term ($\overline{X}$=2,71), while it has a positive effect ($\overline{X}$=3,62) during the fall term.

Following the data, the arithmetic average of subcriteria has been gathered under the related criteria which have been covered by the survey. Table 5 demonstrates a general evaluation of comfort conditions.

Information to a certain level regarding the comfort conditions of participant students has been obtained from the calculations. Accordingly, spatial comfort is sufficient ($\overline{X}$ =3,52), while visual comfort ($\overline{X}$=2,96), auditory comfort ($\overline{X}$ =2,72), and thermal comfort ($\overline{X}$=3,16), have been evaluated as "*neither sufficient nor insufficient*". These data indicate that the comfort conditions of students are at medium level.

Statistical Findings

Participating students stated their level of satisfaction with remote learning as "*quite dissatisfied*" (%21,8), "*dissatisfied*" (%28,2), "*neither satisfied nor dissatisfied*" (%29,1), "*satisfied*" (%18,2), and "*quite satisfied*" (%2,7). Besides, 67.3% of the participant students have expressed that they prefer face-to-face learning over remote learning, within the context of specified comfort conditions. According to this information, it has been found that the satisfaction of the sample group with distance learning is negative. To analyze the relationship between satisfaction level and comfort conditions, multiple regression analysis has been applied to the data which have been obtained from the descriptive analysis of comfort conditions. Before analysis, normality tests have been performed on the data, to test if the data has distributed normally. The number of samples which were greater than 50 allowed for checking the significance values via the Kolmogorov-Smirnov Test. Since the P-value is less than 0.05, it has been determined that data has not been distributed normally. However, it has also been found that kurtosis and skewness values regarding the data are between -1.5 and +1.5, therefore it has been accepted as an indicative for normal distribution of data (Tabachnick & Fidell, 2011). Taking these values into consideration, it has been accepted that data has been distributed normally, allowing the analysis to proceed (Table 6).

Table 5. General evaluation of comfort conditions

Criteria	N		$\overline{X}$	σ
	Valid	Miss.		
Spatial Comfort	110	0	3,52	0,70
Visual Comfort	110	0	2,96	0,55
Auditory Comfort	110	0	2,72	0,89
Thermal Comfort	110	0	3,16	0,80

In multiple regression analysis, high correlation relations within more than one variable cause a problem of multiple linearities. Therefore, before evaluating the results, the Pearson correlation of independent variables in Table 7 has been analyzed and found as no greater than 0.700.

As another indicator that the variables do not correlate, Durbin-Watson parameter, which has been Table 8, has been found as 2.00 approximately (Durbin & Watson, 1971). In parallel, VIF coefficients, which have been asserted in Table 9, be under 2.5 and therefore have indicated the absence of multiple linearities (Allison, 1999). Following the multiple linearity check, the results of the findings have been evaluated.

The results have demonstrated the multiple correlation coefficient value between satisfaction with distance learning and comfort conditions, which has been presented with "R" as 0.374 (Table 8). The mentioned value indicates a weak relationship between the dependent variable and all independent variables. Adjusted R_2, which can be explained as the level of interpretation of the dependent variable by the interdependent variables, has been found as 0.107 (Table 8), which means that the ability of comfort conditions of students to explain their satisfaction level is 10.7%.

In order to determine the existence of a linear relationship between satisfaction with remote learning (dependent variable) and spatial, visual, auditory, and thermal comfort (independent variables), hypotheses of H_0 and H_1 have been determined as follows:

H_0:$\beta_1=\beta_2=\beta_3=\beta_4=0$

H_1: *at least one of* β_1, β_2 β_3 ,*or* β_4 *explains Y*

Table 6. Results of Normality Test

Statistics	Satisfaction	Spatial Comfort	Visual Comfort	Auditory Comfort	Thermal Comfort
N					
Valid	110	110	110	110	110
Missing	0	0	0	0	0
Skewness	.181	-.423	-.085	.516	-.211
Std. Error of Skewness	.230	.230	.230	.230	.230
Kurtosis	-.875	-.099	-.102	-.784	-.367
Std. Error of Kurtosis	.457	.457	.457	.457	.457

Table 7. Correlation findings

Correlations	Y	X1	X2	X3	X4
Pearson Correlation					
Y	1.000	.235	.327	.137	.085
X1	.235	1.000	.208	.269	.324
X2	.327	.208	1.000	.123	.051
X3	.137	.269	.123	1.000	.236
X4	.085	.324	.051	.236	1.000
Sig. (1-tailed)					
Y	.	.007	<.001	.077	.190
X1	.007	.	.014	.002	.000
X2	.000	.014	.	.100	.297
X3	.077	.002	.100	.	.006
X4	.190	.000	.297	.006	.
N					
Y	110	110	110	110	110
X1	110	110	110	110	110
X2	110	110	110	110	110
X3	110	110	110	110	110
X4	110	110	110	110	110

The variance analysis has proven that the level of significance is 95% (Sig. =P=0.003 which translates into the rejection of H_0. Therefore, the result of this test demonstrates that a linear relationship exists between the satisfaction with distance learning and at least one of four independent variables (spatial, visual, auditory, and thermal comfort) entering the model (Table 10).

Including B, standard error of B, β (Beta), t, and sig. values, Table 9 gives the effect of each independent variable on the dependent variable. Within the chosen level of significance (%95), it has been found that spatial, auditory, and thermal comfort variables do not have a significant effect on regression (Sig.>0.05), while the visual comfort variable affects regression significantly (Sig.=0.03 <0.05).

Taking the variation coefficient into consideration, placed in the unstandardized column B of Table 9, it has been found that the coefficient value of the relationship between the visual comfort variable and satisfaction with distance learning is 0.574. This can be translated as a change of 1 unit in the visual comfort conditions of students may correspond to a linear change of 0.574 units to their satisfaction levels with remote learning (Formula 3).

$$\boldsymbol{Y} = -0.274 + 0.574X_1 \quad (3)$$

DISCUSSION

A part of the design students studying in Turkey are dissatisfied with remote learning. The results of this study include that 20.4% of participating students are satisfied or quite satisfied with distance learning. It is expected that, since the Covid-19 pandemic has forced a switch to remote learning while every country has had different levels of preparedness to such change in education processes (Aristovnik et al., 2020), similar studies from different countries have different results (Arifiati et al., 2020; Boca, 2021; Jiang et al., 2021; Realyvásquez-Vargas et al., 2020). Several parameters may affect student satisfaction. As stated by Yang and Moon (2019), dividing satisfaction into

Table 8. Model findings

Model Summary[b]											
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R^2 Change	F Change	df1	df2	Sig. F Change	
1	.374[a]	.140	.107	1.04577	.140	4.259	4	105	.003	1.946

[a] Predictors: (Constant), thermal comfort, visual comfort, auditory comfort, spatial comfort; [b] Dependent Variable: satisfaction.

Table 9. Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1									
a	-.274	.729		-.376	.708	-1.719	1.171		
X1	.249	.157	.158	1.590	.115	-.061	.559	.827	1.209
X2	.574	.186	.287	3.092	.003	.206	.943	.951	1.052
X3	.072	.118	.058	.610	.543	-.162	.306	.898	1.114
X4	.006	.134	.005	.048	.962	-.259	.272	.870	1.149

Table 10. Variance analysis

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	18.631	4	4.658	4.259	.003[b]
	Residual	114.832	105	1.094		
	Total	133.464	109			

[a] Dependent Variable: satisfaction; [b] Predictors: (Constant), thermal comfort, visual comfort, auditory comfort, spatial comfort.

categories and determining the effect of such categories on general satisfaction is a complex process. It has been known that in traditional education, the classroom environment has a significant effect on student satisfaction (Frontczak & Wargocki, 2011; Krüger & Zannin, 2004; M. C. Lee et al., 2012). Therefore, it is possible to relate physical comfort in home environments to satisfaction with remote learning (Oskaloğlu & Çatı, 2021).

One of the most recent studies (Tleuken et al., 2022) reveals that there is a significant relationship between physical environmental conditions and students' satisfaction with remote learning. However, it also mentions that their field of study can have an additional effect on such relationships. Students' field of study may determine their expectations by means of physical comfort conditions. A study conducted with agricultural faculty students (Muthuprasad et al., 2021) has shown that 70% of the students attent remote distance learning only with smart cell phones, while another study which has been conducted with architecture faculty students have emphasized that students lack certain technical equipment and requirements (Ibrahim et al., 2021).

Due to its nature containing concepts of creative thinking and learning by doing (Akin & Akin, 1996; Taneri & Dogan, 2021), it is possible for design education to require different requirements and comfort-related expectations compared to other study fields. This has constructed the base for this article, which has limited the frame of work with design students. The students who have participated in this study stated their spatial comfort conditions as "*sufficient*" ($\overline{X}$=3,52), while they also expressed their visual ($\overline{X}$=2,96), auditory ($\overline{X}$=2,72), and thermal conditions ($\overline{X}$=3,16) as "*neither sufficient nor insufficient*". Having evaluated these results to relate them with their general satisfaction, this study has shown that, as the correlation between comfort perceptions of students and their level of satisfaction with remote learning has demonstrated, the direct effect of the built environment on student satisfaction is relatively low (R=0.374). This result can be explained by the consideration that alongside physical comfort conditions, students are subject to more than one factor (V.-H. Lee et al., 2021). Similar studies which have specifically focused on architecture students have proven the existence of psychological (Ibrahim et al., 2021) and psychosocial (Alnusairat et al., 2021) factors. It is obvious that various combinations of more than one comfort factor affect general satisfaction. Hence, it can be inferred that the power of at least one of the comfort conditions of the findings is quite sufficient (Adjusted R^2= 0.107).

The findings of multiple correlations indicate that spatial, auditory, and thermal comfort do not have a significant effect on student satisfaction. This result is notable since it goes against the studies which have asserted that thermal and auditory comfort has a significant effect on satisfaction (Buratti et al., 2018; Frontczak & Wargocki, 2011; Krüger & Zannin, 2004; Realyvásquez-Vargas et al., 2020; W. Yang & Moon, 2019). However, the difference in findings can be explained with the fact that previous studies have been conducted focusing on the classroom environment and that they have covered not only architectural students. This may translate into the perceptions and expectations of the students that differ between the classroom and home environments.

Multiple regression analyses have shown that there is a positive significant correlation between visual comfort and satisfaction (B=0.574) (sig.=0.003). This finding makes this study in accordance with other related research along with the result which indicates that visual comfort has a significant effect on student satisfaction. And also shows that a change of 1 unit in visual comfort conditions corresponds to a change of 0.6 units in student satisfaction with remote learning.

Discussions related to the significance of comfort factors on learning performance and student satisfaction with remote learning remain. While Yang and Mak (2020) have found that thermal comfort is more effective compared to other comfort factors, Yang and Moon (2019) assert that auditory comfort has more significance. On the other hand, the findings of Ricciardi and Buratti (2018) support the findings of this study by demonstrating visual comfort is more effective on learning performance and satisfaction.

It has not been possible to compare the findings of this study with other research, since the number of studies focusing on design students and home environment is very few. The limitations of this study can be accepted as its national scale and regional coverage. It would be possible to obtain comparable and generalizable results in case of repetition of this study on different cities and countries with wider participation.

CONCLUSION

This study has been done during the period when higher education students were educated completely online, during the period of full closures in line with the Covid-19 restrictions. Since 2022, higher education continues within the boundaries of the hybrid education model. The study

aims to investigate and evaluate the effect of a home-built environment on satisfaction with remote learning during the Covid-19 pandemic. Limited to the focus on architecture and interior architecture design students, this study measures the effect of comfort conditions in increasing student satisfaction with remote learning. And shows that comfort conditions have a relatively low direct impact on student satisfaction. Because there are various parameters affecting satisfaction (academic success, accessibility to resources, socioeconomic conditions, etc.).

Focusing on Turkey, this article has evaluated the spatial, visual, auditory, and thermal comfort conditions of design students attending remote learning programs. It has been found that the spatial comfort conditions of the students are at a better level compared to other comfort conditions, and visual comfort conditions have more effect on satisfaction with remote learning compared to other comfort conditions. It is intelligible that students emphasize natural and artificial lighting while their basic requirements include drawing, modeling, and working on project details. The effect of visual comfort is more powerful than the single effect of the built environment on student satisfaction. This change could include very simple improvements such as a change in the location of the working desk, improvement in lighting fittings, or applying desktop lighting equipment. Performing general notifications to students regarding comfort conditions could constitute a simple yet very effective solution to increase student satisfaction with remote learning.

Remote learning offers a great opportunity for achieving continuous, uninterrupted education during the Covid-19 pandemic or possible obligatory limitations. To achieve healthier education processes, it is important for decision-makers to focus on living areas and for researchers to investigate student performance and satisfaction within the context of remote learning, which might remain permanent in various study fields. This article contributes to the literature by performing a systematic analysis of the comfort perceptions and qualitative assessment of the students.

In the remote learning process, there are sub-factors such as student dimension, instructor dimension, course content, and environmental comfort conditions that affect the student's attendance and learning level. The mutual positive interaction of all these factors improves students' satisfaction with remote education positively. Examining the relationships between instructors and environmental comfort conditions, which is not referred to in this study, maybe a subject of future studies. Because the high comfort conditions in the place where the instructor is located can positively increase work performance and the level of knowledge transfer. This situation can directly increase satisfaction with remote education by affecting students' interest in the course.

The approach of this study can be applied to different student groups which have specific requirements in terms of studying. By this means, this study leads the way for future studies. For future studies, this article suggests investigating the opportunities and limitations affecting the design talents and creativity of students during remote learning processes. Another research topic that we think is important to examine in future studies is the improvement of the hybrid education process. A comparative study to evaluate the learning satisfaction of students receiving remote education and students receiving face-to-face education will reveal important information in the field of educational studies. In this way, it can be provided to understand the new challenges produced by the remote education process and how these can be addressed to increase students' learning satisfaction. Such a study can make a positive contribution to the development of the relationship between student satisfaction and environmental comfort conditions in the hybrid education process.

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REFERENCES

Akin, Ö., & Akin, C. (1996). Frames of reference in architectural design: Analysing the hyperacclamation (A-h-a-!). Design Studies, 17(4 SPEC. ISS.), 341–361. https://doi.org/10.1016/S0142-694X(96)00024-5

Allen, I. E., & Seaman, J. (2013). Changing course: Ten years of tracking online education in the United States.

Allison, P. D. (1999). Multiple regression: A primer. Pine Forge Press.

Alnusairat, S., Al Maani, D., & Al-Jokhadar, A. (2021). Architecture students' satisfaction with and perceptions of online design studios during COVID-19 lockdown: The case of Jordan universities. Archnet-IJAR, 15(1), 219–236. https://doi.org/10.1108/

ARCH-09-2020-0195

Arifiati, N., Nurkhayati, E., Nurdiawati, E., Pamungkas, G., Adha, S., Purwanto, A., Julyanto, O., & Azizi, E. (2020). University students online learning dystem during Covid-19 pandemic: Advantages, constraints and solutions. Systematic Reviews in Pharmacy, 11(7), 570–576.

Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., & Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education students: A global perspective. Sustainability, 12(20), 8438. https://doi.org/10.3390/su12208438

Benoliel, M. A., Manso, M., Ferreira, P. D., Silva, C. M., & Cruz, C. O. (2021). "Greening" and comfort conditions in transport infrastructure systems: Understanding users' preferences. Building and Environment, 195(February), 107759. https://doi.org/10.1016/j.buildenv.2021.107759

Bluyssen, P. M. (2017). Health, comfort and performance of children in classrooms – New directions for research. Indoor and Built Environment, 26(8), 1040–1050. https://doi.org/10.1177/1420326X16661866

Boca, G. D. (2021). Factors influencing students' behavior and attitude towards online education during covid-19. Sustainability (Switzerland), 13(13). https://doi.org/10.3390/su13137469

Bouwens, J., Hiemstra-van Mastrigt, S., & Vink, P. (2018). Ranking of human senses in relation to different in-flight activities contributing to the comfort experience of airplane passengers. International Journal of Aviation, Aeronautics, and Aerospace. https://doi.org/10.15394/ijaaa.2018.1228

Buratti, C., Belloni, E., Merli, F., & Ricciardi, P. (2018). A new index combining thermal, acoustic, and visual comfort of moderate environments in temperate climates. Building and Environment, 139(April), 27–37. https://doi.org/10.1016/j.buildenv.2018.04.038

Council of Higher Education. (2021). Report, Access Date: 01.03.2022. https://covid19.yok.gov.tr/Documents/anketler/ogrenci-anket-sonuclari.pdf

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16(3), 297–334. https://doi.org/10.1007/BF02310555

Durbin, J., & Watson, G. S. (1971). Testing for serial correlation in least squares regression. III. Biometrika, 58(1), 1. https://doi.org/10.2307/2334313

Fantozzi, F., & Rocca, M. (2020). An extensive collection of evaluation indicators to assess occupants' health and comfort in indoor environment. Atmosphere, 11(1), 90. https://doi.org/10.3390/atmos11010090

Frontczak, M., & Wargocki, P. (2011). Literature survey on how different factors influence human comfort in indoor environments. Building and Environment, 46(4), 922–937. https://doi.org/10.1016/J.BUILDENV.2010.10.021

Giresun Erdoğan, B., & Polatoğlu, Ç. (2021). Building performance evaluation for adaptive reuse: A multi-criteria approach. Civil Engineering and Architecture, 9(7), 2427–2440. https://doi.org/10.13189/cea.2021.090728

Haverinen-Shaughnessy, U., Shaughnessy, R. J., Cole, E. C., Toyinbo, O., & Moschandreas, D. J. (2015). An assessment of indoor environmental quality in schools and its association with health and performance. Building and Environment, 93(P1), 35–40. https://doi.org/10.1016/j.buildenv.2015.03.006

Ibrahim, A. F., Attia, A. S., Bataineh, A. M., & Ali, H. H. (2021). Evaluation of the online teaching of architectural design and basic design courses case study: College of architecture at JUST, Jordan. Ain Shams Engineering Journal, 12(2), 2345–2353. https://doi.org/10.1016/j.asej.2020.10.006

Jiang, H., Islam, A. Y. M. A., Gu, X., & Spector, J. M. (2021). Online learning satisfaction in higher education during the COVID-19 pandemic: A regional comparison between Eastern and Western Chinese universities. Education and Information Technologies, 26(6), 6747–6769. https://doi.org/10.1007/s10639-021-10519-x

Jin, Y., Jin, H., & Kang, J. (2020). Combined effects of the thermal-acoustic environment on subjective evaluations in urban squares. Building and Environment, 168, 106517. https://doi.org/10.1016/j.buildenv.2019.106517

Karasar, N. (2017). Bilimsel araştırma yöntemi (32nd ed.). Nobel Akademik Yayıncılık.

Karassowitsch, M. (2019). Researching the efficacy of studio education and the profession's futurity. Journal of Contemporary Urban Affairs, 3(3), 1–14. https://doi.org/10.25034/ijcua.2019.v3n3-1

Krüger, E. L., & Zannin, P. H. T. (2004). Acoustic, thermal and luminous comfort in classrooms. Building and Environment, 39(9), 1055–1063. https://doi.org/10.1016/j.buildenv.2004.01.030

Lamberti, G., Fantozzi, F., & Salvadori, G. (2020). Thermal comfort in educational buildings: Future directions regarding the impact of environmental conditions on students' health and performance. 2020 IEEE International Conference on Environment and Electrical Engineering and 2020 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe), 1–6. https://doi.org/10.1109/EEEIC/ICPSEurope49358.2020.9160680

Lee, M. C., Mui, K. W., Wong, L. T., Chan, W. Y., Lee, E. W. M., & Cheung, C. T. (2012). Student learning performance and indoor environmental quality (IEQ) in air-conditioned university teaching rooms. Building and Environment, 49(1), 238–244. https://doi.

org/10.1016/j.buildenv.2011.10.001

Lee, V.-H., Hew, J.-J., Leong, L.-Y., Tan, G. W.-H., & Ooi, K.-B. (2021). The dark side of compulsory e-education: Are students really happy and learning during the COVID-19 pandemic? International Journal of Human–Computer Interaction, 1–14. https://doi.org/10.1080/10447318.2021.1987681

Muthuprasad, T., Aiswarya, S., Aditya, K. S., & Jha, G. K. (2021). Students' perception and preference for online education in India during COVID -19 pandemic. Social Sciences & Humanities Open, 3(1). https://doi.org/10.1016/j.ssaho.2020.100101

Nicol, D., & Pilling, S. (2000). Architectural education and the profession: Preparing for the future. In D. Nicol & S. Pilling (Eds.), Changing Architectural Education (1st ed., pp. 20–40). Taylor & Francis. https://doi.org/10.4324/9780203992340-10

Oral Erbaş, S. (2018). Olasılık ve istatistik problemler ve çözümleri ile (6th ed.). Gazi Kitapevi.

Oral, G. K., Yener, A. K., & Bayazit, N. T. (2004). Building envelope design with the objective to ensure thermal, visual and acoustic comfort conditions. Building and Environment, 39(3), 281–287. https://doi.org/10.1016/S0360-1323(03)00141-0

Oskaloğlu, E., & Çatı, K. (2021). Uzaktan eğitimde ergonomik çalışma koşullarının öğrenci memnuniyetine etkisi. Social Mentality And Researcher Thinkers Journal, 7(45), 1022–1044. https://doi.org/10.31576/smryj.870

Özçiftçi, V. (2021). Uzaktan eğitimde öğrenci memnuniyeti. Social Sciences Studies Journal, 7(76), 297–304. https://doi.org/10.26449/sssj.2945

Realyvásquez-Vargas, A., Maldonado-Macías, A. A., Arredondo-Soto, K. C., Baez-Lopez, Y., Carrillo-Gutiérrez, T., & Hernández-Escobedo, G. (2020). The impact of environmental factors on academic performance of university students taking online classes during the COVID-19 pandemic in Mexico. Sustainability, 12(21), 9194. https://doi.org/10.3390/su12219194

Ricciardi, P., & Buratti, C. (2018). Environmental quality of university classrooms: Subjective and objective evaluation of the thermal, acoustic, and lighting comfort conditions. Building and Environment, 127(September 2017), 23–36. https://doi.org/10.1016/j.buildenv.2017.10.030

Rosa-Jimenez, C., & Jaime-Segura, C. (2021). Living space needs of small housing in the post-pandemic era: Malaga as a case study. Journal of Contemporary Urban Affairs, 6(1), 51–58. https://doi.org/10.25034/ijcua.2022.v6n1-5

Saghafi, M.R., Franz, J. and Crowther, P. (2012). A holistic blended design studio model : A basis for exploring and expanding learning opportunities. Society for Information Technology and Teacher Education International Conference.

Salama, A. M., & Wilkinson, N. (2017). Design studio pedagogy: Horizons for the future. The Urban International Press, Gateshead.

Silva, N. F., & Lima, E. M. (2008). Distance learning in architectural design studio: Two comparative studies with one onsite teaching. In Innovative Techniques in Instruction Technology, E-learning, E-assessment, and Education (pp. 381–386). Springer Netherlands. https://doi.org/10.1007/978-1-4020-8739-4_66

Soccio, P. (2016). A new post cccupancy evaluation tool for assessing the indoor environment quality of learning environments. In W. Imms, B. Cleveland, & K. Fisher (Eds.), Evaluating Learning Environments (pp. 195–210). Sense Publishers. https://doi.org/10.1007/978-94-6300-537-1_14

Sun, A., & Chen, X. (2016). Online education and its effective practice: A research review. Journal of Information Technology Education: Research, 15(2016), 157–190. https://doi.org/10.28945/3502

Şekerci, Y., Mutlu Danacı, H., & Kaynakçı Elinç, Z. (2021). Uzaktan eğitimin uygulamalı derslerde sürdürülebilirliği: Mimarlık bölümleri örneği. Mehmet Akif Ersoy Üniversitesi Fen Bilimleri Enstitüsü Dergisi. https://doi.org/10.29048/makufebed.874055

Tabachnick, B. G., & Fidell, L. S. (2011). Multivariate analysis of variance (MANOVA). In International Encyclopedia of Statistical Science (pp. 902–904). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-04898-2_394

Taneri, B., & Dogan, F. (2021). How to learn to be creative in design: Architecture students' perceptions of design, design process, design learning, and their transformations throughout their education. Thinking Skills and Creativity, 39(October 2020), 100781. https://doi.org/10.1016/j.tsc.2020.100781

Tleuken, A., Turkyilmaz, A., Unger, K., Tokazhanov, G., El-Thalji, I., Mostafa, M. Y., Guney, M., & Karaca, F. (2022). Which qualities should built environment possess to ensure satisfaction of higher-education students with remote education during pandemics? Building and Environment, 207(PB), 108567. https://doi.org/10.1016/j.buildenv.2021.108567

Toyinbo, O., Shaughnessy, R., Turunen, M., Putus, T., Metsämuuronen, J., Kurnitski, J., & Haverinen-Shaughnessy, U. (2016). Building characteristics, indoor environmental quality, and mathematics achievement in Finnish elementary schools. Building and Environment, 104, 114–121. https://doi.org/10.1016/j.buildenv.2016.04.030

Unesco. (2020). COVID-19 Educational disruption and response. https://en.unesco.org/themes/educatione-

mergencies/coronavirus-school-closures

Vilcekova, S., Meciarova, L., Burdova, E. K., Katunska, J., Kosicanova, D., & Doroudiani, S. (2017). Indoor environmental quality of classrooms and occupants' comfort in a special education school in Slovak Republic. Building and Environment, 120, 29–40. https://doi.org/10.1016/j.buildenv.2017.05.001

Wojtowicz, J. (1995). Virtual design studio (vol.1). Hong Kong University Press.

Yang, D., & Mak, C. M. (2020). Relationships between indoor environmental quality and environmental factors in university classrooms. Building and Environment, 186, 107331. https://doi.org/10.1016/J.BUILDENV.2020.107331

Yang, W., & Moon, H. J. (2018). Combined effects of sound and illuminance on indoor environmental perception. Applied Acoustics, 141, 136–143. https://doi.org/10.1016/j.apacoust.2018.07.008

Yang, W., & Moon, H. J. (2019). Combined effects of acoustic, thermal, and illumination conditions on the comfort of discrete senses and overall indoor environment. Building and Environment, 148, 623–633. https://doi.org/10.1016/j.buildenv.2018.11.040

Yang, Z., Becerik-Gerber, B., & Mino, L. (2013). A study on student perceptions of higher education classrooms: Impact of classroom attributes on student satisfaction and performance. Building and Environment, 70, 171–188. https://doi.org/10.1016/j.buildenv.2013.08.030