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# A COMPARATIVE ASSESSMENT OF USER SATISFACTION THROUGH COMFORT CONDITIONS IN EDUCATION BUILDINGS[1-2]

# EĞİTİM BİNALARINDA KULLANICI MEMNUNİYETİNİN KONFOR KOŞULLARI ÜZERİNDEN KARŞILAŞTIRMALI BİR DEĞERLENDİRMESİ

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**Abstract: Aim:** The study aimed to measure user satisfaction in the education buildings on comfort conditions, to determine and evaluate the significant criteria for the users of education buildings.

**Method:** A conceptual scale is developed. Two architectural education buildings of Adana Science and Technology University are evaluated comparatively through the developed scale and the scale is tested. The data required during the analysis and evaluation process are obtained from the survey studies that are carried out with the architecture students.

**Results:** After the analyzes; visual comfort, auditory comfort, thermal comfort, spatial comfort and air quality were determined as the dimensions of the scale. The scale was tested and it is confirmed that the scale is at the level that can distinguish the conditions of user satisfaction thanks to the analysis as well as the case studies.

**Conclusion:** The literature review shows that there is a need for a more holistic and collective user satisfaction understanding within the context of comfort conditions. The scale, developed to meet this need, can be used for not only post-use evaluation and development in the use/operational process of education buildings, but also has the potential to be used in the planning and design stages.

***Keywords:*** User Experience, Conceptual Scale, Environmental Conditions, Physical Environment Control

**Öz: Amaç:** Bu çalışmada, eğitim yapılarında kullanıcı memnuniyetini konfor koşulları üzerinden ölçebilmek, eğitim yapılarının kullanıcıları için önemli olan ölçütleri tespit edebilmek ve değerlendirebilmek amaçlanmıştır.

**Yöntem:** Çalışmanın amacı doğrultusunda kavramsal bir ölçek geliştirilmiştir. Ölçeğin boyutları ve göstergeleri, konu ile ilgili literatürdeki mevcut çalışmalar dikkate alınarak oluşturulmuştur. Çalışma kapsamında Adana Bilim ve Teknoloji Üniversitesi Mimarlık Bölümü'nün 2 ayrı binası, geliştirilen ölçek aracılığıyla karşılaştırmalı olarak değerlendirilmiş ve ölçek test edilmiştir. Analiz ve değerlendirme sürecinde ihtiyaç duyulan veriler, incelenen yapıların kullanıcıları olan mimarlık öğrencileri ile gerçekleştirilen anket çalışmaları ile elde edilmiştir.

**Bulgular:** Analizler sonrasında; ölçeğin boyutları olarak görsel konfor, işitsel konfor, termal konfor, mekânsal konfor ve hava kalitesi belirlenmiştir. Her bir boyutun parametreleri yapılan analizler sonucunda son haline ulaşmıştır. Çalışma kapsamında eğitim binaları için hazırlanan konfor koşulları ölçeği test edilmiş/uygulanmıştır. Yapılan analizlerin yanı sıra örnek alan analiziyle de ölçeğin kullanıcı memnuniyet/memnuniyetsizlik durumlarını ayırt edebilecek düzeyde olduğu teyit edilmiştir.

**Sonuç:** Literatür taraması, konfor koşulları bağlamında daha bütüncül ve kolektif bir kullanıcı memnuniyeti anlayışına ihtiyaç olduğunu göstermektedir. Bu ihtiyacı karşılamak üzere geliştirilen ölçek, eğitim yapılarının kullanım/işletme sürecinde kullanım sonrası değerlendirme ve geliştirmenin yanı sıra planlama ve tasarım aşamalarında da kullanılabilme potansiyeline sahiptir.

***Anahtar Kelimeler:*** Kullanıcı Deneyimi, Kavramsal Ölçek, Çevresel Koşullar, Fiziksel Çevre Denetimi

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***[2] Çalışma, araştırma ve yayın etiğine uygun olarak hazırlanmıştır. Çalışmada herhangi bir intihale rastlanmamış olup dergi kapsamında istenen %20 alıntı oranına uygun olarak hazırlandığı bu yönlerden makalenin tüm sorumluluğu ile bilgilerin doğruluğu ilgili yazar(lar) tarafından kabul edilmiştir. İşbu makalenin her türlü telif ve sair diğer hakları açık erişim olmak üzere yazar(lar) tarafından dergiye devredilmiştir. "The study was prepared in accordance with research and publication ethics. No plagiarism was found in the study and it was prepared in accordance with the 20% citation rate required within the scope of the journal, and in these respects, the full responsibility of the article and the accuracy of the information has been accepted by the relevant author(s). All copyright and other rights of this article have been transferred to the journal by the author(s) as open access."***

## INTRODUCTION

According to the standard definition of the International Organization for Standardization (ISO)'s report numbered 9241-11 in the section where human and system interactions are explained, user satisfaction is the extent to which the physical, cognitive and emotional reactions of the user that result from the use of a system, product or service satisfy the user's needs and expectations. User satisfaction includes the extent to which the user experience that results from actual use meets the user's needs and expectations (ISO 9241-11, 2018). The adverse outcomes regarding health, security, finance or environment originating from the use can be effective on the user or other stakeholders. Thus, the perceptions and feedbacks of the user that result from the use or anticipated use of a system, product or service are important in determination of user satisfaction. In Section 220 of the report numbered ISO 9241, importance of the concept "people-oriented quality", which expresses the extent to which the requirements of usability, accessibility, user experience and harm avoidance due to use are met, is emphasized (ISO 9241-220, 2019).

In their book titled "Process and Guidelines for Ensuring a Quality User Experience", Hartson and Pyla state that the pair of technology and design is not just the instruments enhancing productivity, but also has transformed into the instruments that affect more personal, social and intimate aspects of our lives. Thus, it is necessary to look at what forms quality in designs and there is a need to have a much broader definition of quality in the user experience where the designs actually start. In the light of these ideas, the researchers mention that user satisfaction is a result of how the users experience usability (Hartson & Pyla, 2012). Magalhaes mentions that there are two types of definition based on the distinct approaches for "user satisfaction" in general. While process-oriented approach as the first type considers user satisfaction as the gap between expected satisfaction and achieved satisfaction, result-oriented approach regards user satisfaction as an attribute that is removed from a system, product or service after use (Magalhaes de Sá, 2008). Satisfaction encourages the users to stay, while also encouraging other individuals to step in. On the other hand, low satisfaction impels users to move away and seek new places (Hur & Morrow-Jones, 2008). If the education buildings are addressed within this context, it is very important for the education buildings, which are the environments that information is produced and shared, to provide comfortable environments with regard to its users' satisfaction. Being able to conduct qualified researches and providing comprehensive education in these environments is not only related to the academic environment, but also to the environment created by the physical and social environments. When evaluated from this perspective, the fact that the environments offered by the education buildings have the nature of meeting comfort conditions concerning the study is a supportive factor in offering a more qualified educational environment.

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## AIM

The study is aimed to measure user satisfaction in the education buildings on comfort conditions, to determine and evaluate the significant criteria for the users of education buildings. In accordance with the purpose of the study, a conceptual scale is developed. The literature review shows that there is a need for a more holistic and collective user satisfaction understanding within the context of comfort conditions. The scale, developed to meet this need, can be used for not only post-use evaluation and development in the use/operational process of education buildings, but also has the potential to be used in the planning and design stages.

## SCOPE

Within the scope of the study, two architectural education buildings of Adana Science and Technology University, which is in Adana, Turkey, are evaluated comparatively through the developed scale and the scale is tested. The data required during the analysis and evaluation process are obtained from the survey studies that are carried out with the architecture students.

## METHOD OF THE RESEARCH

During the scale development process, available studies/publications on the subject in the literature are firstly examined. The indicators that constitute the scale of the study are identified by taking into account the factors given in the mentioned available studies. The indicators are classified under the main dimensions and the first version of the scale of comfort conditions was revealed. As a result of the literature review, the determination of the indicators and the elimination process are explained in detail after the theoretical framework section.

The scale consists of five dimensions as visual comfort, auditory comfort, thermal comfort, spatial comfort and air quality. The indicators under the dimensions have also been created specifically for educational buildings. Several analyses are made in order to determine the suitability of the scale for use. Table 1 shows the final status of Comfort Conditions scale after the analysis and arrangements. After the final version of the scale was reached, questions were prepared in accordance with the 5-point Likert scale for the users (students) of the 2 buildings to be examined. Care was taken to ensure that the questions met the indicators in the scale.

**Table 1.** Final Status of Comfort Conditions Research Scale as a Result of the Analysis (Prepared by Author)

| DIMENSION | INDICATOR |
|---|---|
| Visual Comfort | • Natural lighting<br>• Artificial lighting (regional sufficiency/insufficiency of lamps, led or spotlights)<br>• Equipment selected for artificial lighting (Spot/led lighting, etc.)<br>• Artificial lighting elements with sensors |
| Auditory Comfort | •Sounds originating from internal and external units of HVAC (heating, cooling, ventilation)<br>• Acoustics of studios/classrooms |
| Thermal Comfort | • Heating level and balance of spaces<br>• Cooling level and balance of spaces<br>• Heating/cooling level and balance of building common areas |

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| | |
|---|---|
| | • Control system of heating/cooling equipment (the conditions that there is a central system or each space/studio has its own control system and ease of use). |
| **Spatial Comfort** | • Space organization and indoor space design (plan, transitions and relation between the spaces, space sizes, flexibility)<br>• Layout, dimensions, quality of fixed reinforcements, doors/windows and fixtures used in wet areas (faucets, etc.)<br>• Layout, dimensions and quality of mobile reinforcements (tables, chairs, etc.)<br>• Availability of building to work all hours (day/night)<br>• Common areas in the building (entrance, corridors, terraces, etc.) |
| **Air Quality** | • Amount of fresh air indoors provided by natural ventilation<br>• Dry air that circulates inside<br>• Air pollution related smells<br>• Smell of materials<br>• Toilet smells<br>• Dampness smells |

## Testing Scale Reliability

It is subjected to the Cronbach's Alpha internal consistency test in order to test reliability of Comfort conditions scale and sub-dimension scores. Alpha coefficient method developed by Cronbach is an estimation method of internal consistency of survey items. Alpha coefficient is defined as the weighted standard change mean calculated the ratio of total variances of certain items in the scale to the general variance (Ercan & Kan, 2004). Cronbach Alpha coefficient is measured by the value between 0 and 1 and the reliability is provided in the values below (İslamoğlu & Alnıaçık, 2014):

If it is $0.01 \leq \alpha < 0.40$, the scale is not reliable.

If it is $0.40 \leq \alpha < 0.60$, reliability of the scale is low.

If it is $0.60 \leq \alpha < 0.80$, reliability of the scale is at an acceptable level.

If it is $0.80 \leq \alpha < 1.00$, reliability of the scale is high.

**Table 2.** Reliability Analysis of the Scale by the Scores

| | Cronbach's Alpha |
|---|---|
| Air Quality Dimension | 0.862 |
| Thermal Comfort Dimension | 0.839 |
| Visual Comfort Dimension | 0.711 |
| Spatial Comfort Dimension | 0.692 |
| Auditory Comfort Dimension | 0.603 |
| General | 0.873 |

When Table 2 is examined, it is found that total scale scores and their sub-dimension are at acceptable and high reliability level.

## LIMITATIONS OF THE RESEARCH

Due to the Covid19 pandemic, there were difficulties in reaching the users. While the survey technique specified in the method section of the study was planned to be carried out face-to-face with the participants, the data of the participants were collected online due to the pandemic. Despite this situation, a total of 90 participants, a sufficient number for the application of the scale, were reached. Detailed information about the participants is given in the findings section.

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## RESEARCH PROBLEM

The study focused on the question of "how does the comfort conditions affect the satisfaction level of the students who use the education buildings?" and the problem of research on student groups using two education buildings with different conditions was investigated.

## RESEARCH SUBPROBLEMS

The sub questions motivating our research are as follows:

RQ1: Does the satisfaction level of users with comfort conditions differ significantly by gender?

RQ2: Does the level of satisfaction of the users with the comfort conditions differ significantly according to the class/year level?

## RESEARCH HYPOTHESES

The fact that the comfort conditions in educational buildings are not provided and considered at an optimum level cause the users to experience problems in the use of the building. This is the reason for the user's increasing dissatisfaction with the environmental and physical conditions.

## THEOROTICAL FRAMEWORK

Comfort is a sense of satisfaction, sense of contentment or a physical and mental well-being (Chappels & Shove, 2004). It is a state of meeting the basic human needs in order to feel at ease (Kolcaba, 1991). Witold Rybczyntski is of the opinion that comfort includes a combination of sensations, many of which are subconscious and not of physical nature, but rather emotional and intellectual (Rybczynski, 1986). In his study, he follows in a chronological order the development of comfort and links it to intimacy, privacy, the need for light, fresh air, etc. For Juhani Pallasmaa, each perception of architecture is of multi-sensory nature and consequently, the quality of space (and with it the comfort itself) is equally assessed by all the senses (Pallasmaa, 2013).

According to Edward T. Hall, the feeling of comfort when using a particular space depends on the presence of other humans and the proxemic distances that determine how the space will be used and perceived (Hall, 1990). For Christian Norberg-Schulz, there are two main criteria determining "the spirit of place": space and character. Schulz defines space as the three-dimensional organization of elements forming that place; on the other hand, character is formed by the atmosphere of that place that can be linked to the sensory perception which resulted as comfort through particular aspects (Norberg-Schultz, 1984).

The concept of comfort conditions is defined as a group of conditions in which a human can adapt to the environment by spending a minimum of energy physiologically and is psychologically satisfied with the environment (Kutlu, 2018). There are some indicators required to provide the comfort conditions. These indicators in this study are addressed as visual comfort, auditory comfort, thermal comfort, spatial comfort and air quality.

**Visual Comfort:** Visual comfort is the ability of users to perceive their environment in all

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without being disturbed by anything. According to the European standard, visual comfort is defined as a state of subjective, visual well-being stimulated by the visual environment (EN 12665, 2018). For the existence of visual comfort, it is necessary to firstly enlighten the environment by natural and/or artificial means. Some conditions should be met at the same time in order to fully provide the visual comfort conditions. These conditions are that the lighted object or surface is within the field of vision and that the relevant information on this object or surface is transferred to the brain by the help of eye and nerves (Manav & Küçükdoğu, 2006). Therefore, the level of lighting is also important. If it is an environment with very intense light, the eyes of the users will be dazzled; if it is an environment with low light, the eyes of the users will be tired. The lighting level must be determined depending on the nature of work. Human health, happiness and welfare are inseparably linked to the sunlight in various building functions. Another factor affecting visual comfort is the distance between the object or the thing and the observer. Distance has an important role in our perception towards the characteristics in the environment such as color, surface attributes, brightness of things.

**Auditory Comfort:** In the environments where many people are together, the necessity of auditory comfort becomes even more important. The sound in the environment should not be very low or high at the noise level in order to provide auditory comfort. The fact that sound vibrations have different frequencies and speed of propagation, that sound does not homogeneously propagate in the space and several personal factors are the parameters that affect the sound to be considered as noise (Yüksel, 2005). As both the noise coming from the outdoor space and also, the noises to be made within the building lead to dissatisfaction in the users, it is necessary to make an acoustic design in indoor space. The building and reinforcement materials with high acoustic properties benefit in terms of auditory comfort. In order to increase the level of auditory comfort in indoor space, noise can be reduced or damped by control at its source, transmission path and receiver (Yanılmaz et al., 2021).

**Thermal Comfort:** Thermal comfort is defined as provision of thermal parameters in which a human can be healthy and productive (Şenkal Sezer, 2005; Korkmaz & Dilbaz Alacahan, 2014). ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) mentions about thermal comfort as "the user's state of being delighted by the conditions in the environment" (ASHRAE, 2003). It is necessary to bring up both heating level and cooling level of the spaces/buildings to the optimum level in order to provide thermal comfort. In addition, the ability of controlling and adjusting temperature of spaces by the user easily is another important condition in terms of thermal comfort.

**Spatial Comfort:** Spatial comfort is an ideal condition between anthropometry of the human body and activity adapted to the function of space (Ginting et al., 2018). It is the degree to which an environment is suitable

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for human use and it is an indicator of spatial quality (Elzeyadi, 2002). It is also the sense of contentment and satisfaction that a person experiences who stays in a space with particular physical, visual and sensory qualities (Алфиревић et al., 2020; Şahin, 2018). According to John Crowley, physical (spatial) comfort means conscious satisfaction of a person by the relationship with his or her body and the intimate physical environment (Crowley, 1999). Physical comfort includes not only sensory contact of a person with his or her intimate environment (that belongs to ergonomics area); but also, the relationship between the dimensions and shapes of a space that the person occupies. Therefore, it can be concluded that visual and sensory perceptions are important aspects for perceiving a space, yet not the only and absolute determinant in providing spatial comfort. The most important factor in perceiving spatial comfort is the physical parameters.

**Air Quality:** Indoor air quality shows how the air in a building affects health, comfort and workableness of the occupants. Air conditions comfort varies depending on the people. Thus, the concept of acceptable air quality is revealed. According to ASRHAE 62-1989 and 2001 Standard, the acceptable indoor air quality is "the air where the identified pollutants are not at the determined levels and that at least 80% of occupants do not feel any dissatisfaction regarding this air" (ASHRAE, 1990; ASHRAE, 2003). According to NIOSH study, the resources of indoor air quality problems are inadequate ventilation (53%), bioaerosols (5%), internal pollution (15%), external pollution (10%), building materials (4%) and unknown causes (13%) (Hammad, 1994).

## THE PROCESS OF DETERMINING AND ELIMINATION OF THE DIMENSIONS AND INDICATORS OF THE SCALE

In the process of developing a scale, the initial step involves reviewing existing studies and publications related to the subject in order to identify the indicators that will be included in the scale. This is done by considering the factors mentioned in the existing studies. The indicators are classified under the main dimensions and the first version of the scale of comfort conditions was revealed. The pre-analysis dimensions and indicators of the scale obtained as a result of the theoretical framework research are given in Table 3.

**Table 3.** Dimensions and Indicators of the Research Scale of Comfort Conditions on Education Buildings Used in the Study Prior to the Analysis (Prepared by Author)

| DIMENSION | INDICATOR | REFERENCES |
|---|---|---|
| **Visual Comfort** | • Natural lighting<br>• Reflection/glare/bloom originating from window/glass or extreme contrast conditions (projection, computer screen, tables, etc.)<br>• Sunlight control in the building<br>• Artificial lighting (regional sufficiency/insufficiency of lamps, led or spotlights)<br>• Equipment selected for artificial lighting (Spot/led lighting, etc.)<br>• Bloom, temperature, shade or vibration that result from artificial lighting<br>• Artificial lighting elements with sensors<br>• Colors used in the spaces<br>•Ability of seeing the blackboard/instructor easily | -Kruger & Dorigo, 2008;<br>-Boduch & Fincher, 2009;<br>-Ural & Ural, 2018 |

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|---|---|---|
| | • Lighting within building environment/landscape area (Open, green areas, social reinforcements) | |
| **Auditory Comfort** | • Sounds originating from internal and external units of HVAC (heating, cooling, ventilation) systems<br>• Noise problem originating from outdoor space<br>• Noise problem originating from indoor space (studios; sounds from corridors, toilets or other studios and classrooms)<br>• Acoustics of studios/classrooms | -Avşar & Gönüllü, 2005;<br>-Elmallawany, 1980;<br>-Elmallawany, 1983 |
| **Thermal Comfort** | • Heating level and balance of spaces<br>• Cooling level and balance of spaces<br>• Heating/cooling level and balance of building common areas<br>• Radial temperature (temperature coming/impinging directly from the heat source) conditions<br>• Control system of heating/cooling equipment (the conditions that there is a central system or each space/studio has its own control system and ease of use). | -Conceição & Lúcio, 2008;<br>-Filippín, 2005<br>-Kwok & Chun, 2003 |
| **Spatial Comfort** | • Space organization and indoor space design (plan, transitions and relation between the spaces, space sizes, flexibility)<br>• Layout, dimensions, quality of fixed reinforcements, doors/windows and fixtures used in wet areas (faucets, etc.)<br>• Layout, dimensions and quality of mobile reinforcements (tables, chairs, etc.)<br>• Storey height<br>• Availability of building to work all hours (day/night)<br>• Vibration originating from the vehicles, users or wind<br>• Circulation areas (width and usefulness of studio circulation areas, stairs, corridors and other areas)<br>• Common areas in the building (entrance, corridors, terraces, etc.) | -Imamoglu, 1976;<br>-Imamoglu, 1986;<br>-Samuelson & Lindaur, 1976;<br>-Алфиревић et al., 2020;<br>-Lourenco et al., 2011 |
| **Air Quality** | • Amount of fresh air indoors provided by natural ventilation<br>• Air flow originating from natural ventilation<br>• Facilities of natural ventilation<br>• Ventilation in wet areas<br>• Air flow originating from HVAC systems<br>• Air quality coming from ventilation system<br>• Dry air that circulates inside<br>• Air pollution related smells<br>• Smell of materials<br>• Toilet smells<br>• Dampness smells | -Bakó-Biró et al., 2008;<br>-Tippayawong et al., 2009;<br>-Sohn et al. 2009;<br>-Becker et al., 2007;<br>-Khedari et al., 2000;<br>-Lappalainen et al., 2001;<br>-Meklin et al., 2002 |

The data needed to make analysis of Comfort Conditions scale were obtained as a result of survey study that was carried out with the students of ATU Architecture Department. All data are analyzed by being saved to IBM SPSS 22 (Statistical Package for Social Sciences) for Windows 2022. The structural validity of the scales used in the research is made using Exploratory Factor Analysis (AFA). Sample competence in AFA is evaluated by Kaiser-Meyer-Olkin (KMO) value and a value above 0.500 was considered satisfactory. The facts that whether the data is derived from the multiple normal distribution is evaluated by Barlett's test of sphericity and that chi square value calculated as a result of the test are significant ($p<0.05$) shows that the values are derived from multiple normal distribution (Altunışık et al., 2012; Erdoğan et al., 2014; Karagöz, 2016). The items, which are of difference dimensions in AFA and uploaded to more than one factor, are removed from the analysis (Büyüköztürk, 2002; Karagöz, 2016).

### Exploratory Factor Analysis Regarding Comfort Conditions Scales

Explanatory factor analysis with varimax rotation is made with principal components method in order to determine principal factors of comfort conditions scale. In the analysis findings, in the scale consisting of 38 items, items 4, 6 and 7 of "Spatial comfort"

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dimension, item 4 of "Thermal comfort" dimension, items 2 and 3 of "Auditory comfort" dimension, items 2, 3, 4, 5 and 6 of "Aerial comfort" dimension, items 2, 3, 6, 8, 9 and 10 of "Visual comfort" dimension focus on more than one dimension, and also, the items with item loads less than 0.30 were identified and removed one by one from the analysis by the order given and analysis was made again. 5-dimensional structure that is created in the recent analysis explains 58.48% of the total variance. KMO (Kaise-Meyer-Olkin Measure of Sampling Adequacy) sample competence criterion (0.783) and sphericity degree (Barlett's Test of Sphericity= 1070, 87; p=0,001) show that the data is suitable. As found in the analysis findings in Table 2, the factor loads in the items in Air Quality factor are between 0.58 and 0.90, and its eigenvalue is 3.643 and its variance is 14.013%. The factor loads of the items in Thermal Comfort factor as the second factor are between 0.54 and 0.84, its eigenvalue is 3.321 and the variance is 12.774%. The factor loads of the items in Visual Comfort factor as the third factor are between 0.57 and 0.82, its eigenvalue is 2.969 and the variance is 11.420%. The factor loads of the items in Spatial Comfort factor as the fourth factor are between 0.60 and 0.81, its eigenvalue is 2.2663 and the variance is 10.241%. The factor loads of the items in Auditory Comfort factor are between 0.43 and 0.48, its eigenvalue is 2.609 and the variance is 10.003%. The indicators that are decided to be removed from the scale as a result of the analysis are shown as bold in Table 4.

**Table 4.** Results of Exploratory Factor Analysis Regarding Comfort Conditions Scales (Prepared by Author)

| Factors | Factor Loads | Eigen values | Exploratory Variance | % Total Variance |
|---|---|---|---|---|
| **Visual Comfort Dimension** | | 2.969 | 11.420 | 38.207 |
| 1. Natural lighting | 0.57 | | | |
| **2. Reflection/glare/bloom originating from window/glass or extreme contrast conditions (projection, computer screen, tables, etc.)** | | | | |
| **3. Sunlight control in the building** | | | | |
| 4. Artificial lighting (regional sufficiency/insufficiency of lamps, led or spotlights) | 0.82 | | | |
| 5. Equipment selected for artificial lighting (Spot/led lighting, etc.) | 0.76 | | | |
| **6. Bloom, temperature, shade or vibration that result from artificial lighting** | | | | |
| 7. Artificial lighting elements with sensors | 0.59 | | | |
| **8. Colors used in the spaces** | | | | |
| **9. Ability of seeing the blackboard/instructor easily** | | | | |
| **10. Lighting within building environment/landscape area (Open, green areas, social reinforcements)** | | | | |
| **Auditory Comfort Dimension** | | 2.609 | 10.033 | 58.482 |
| 1. Sounds originating from internal and external units of HVAC (heating, cooling, ventilation) systems | 0.48 | | | |
| **2. Noise problem originating from outdoor space** | | | | |
| **3. Noise problem originating from indoor space (studios; sounds from corridors, toilets or other studios and classrooms)** | | | | |
| 4. Acoustics of studios/classrooms | 0.43 | | | |
| **Thermal Comfort Dimension** | | 3.321 | 12.774 | 26.787 |
| 1. I find heating level and balance of spaces suitable. | 0.73 | | | |

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|---|---|---|---|---|
| 2. I find cooling level and balance of spaces suitable. | 0.81 | | | |
| 3. I find heating/cooling level and balance of building common areas suitable. | 0.84 | | | |
| **4. Radial temperature (temperature coming/impinging directly from the heat source) conditions** | | | | |
| 5. I am satisfied with control system of heating/cooling equipment | 0.54 | | | |
| **Spatial Comfort Dimension** | | 2.663 | 10.241 | 48.448 |
| 1. Space organization and indoor space design (plan, transitions and relation between the spaces, space sizes, flexibility) | 0.81 | | | |
| 2. Layout, dimensions, quality of fixed reinforcements, doors/windows and fixtures used in wet areas (faucets, etc.) | 0.67 | | | |
| 3. Layout, dimensions and quality of mobile reinforcements (tables, chairs, etc.) | 0.65 | | | |
| **4. Storey height** | | | | |
| 5. Availability of building to work all hours (day/night) | 0.60 | | | |
| **6. Vibration originating from the vehicles, users or wind** | | | | |
| **7. Circulation areas (width and usefulness of studio circulation areas, stairs, corridors and other areas)** | | | | |
| 8. I am satisfied with common areas in the building (entrance, corridors, terraces, etc.) | 0.71 | | | |
| **Air Quality Dimension** | | 3.643 | 14.013 | 14.013 |
| 1. Amount of fresh air indoors provided by natural ventilation | 0.58 | | | |
| **2. Air flow originating from natural ventilation** | | | | |
| **3. Facilities of natural ventilation** | | | | |
| **4. Ventilation in wet areas** | | | | |
| **5. Air flow originating from HVAC systems** | | | | |
| **6. Air quality coming from ventilation system** | | | | |
| 7. Dry air that circulates inside | 0.61 | | | |
| 8. Air pollution related smells | 0.59 | | | |
| 9. Smell of materials | 0.77 | | | |
| 10. Toilet smells | 0.84 | | | |
| 11. Dampness smells | 0.90 | | | |

## FINDINGS

The buildings examined within the scope of the study through the propositions prepared by considering the contents of indicators as visual comfort, auditory comfort, thermal comfort, spatial comfort and air quality were evaluated on comfort conditions. Comfort conditions scale prepared for the education buildings were tested and applied to students within the scope of the study. The case study is carried out in two separate buildings used for the courses of ATU Architecture Department (Figure 1, 2). In order to obtain clearer and more successful results in the measurement and testing of the indicators in the scale, it was decided to work on two buildings with the same usage characteristics, and therefore two architectural education buildings were selected. The buildings were chosen because one of them (architectural education building 1) is closer to key locations on campus than the other, it has social areas and the building orientation is better. In this way, it will be possible to test whether the scale can give the desired result in the studies of comparing two different situations. The students are expected to evaluate both buildings by taking into account the propositions given in the scale.

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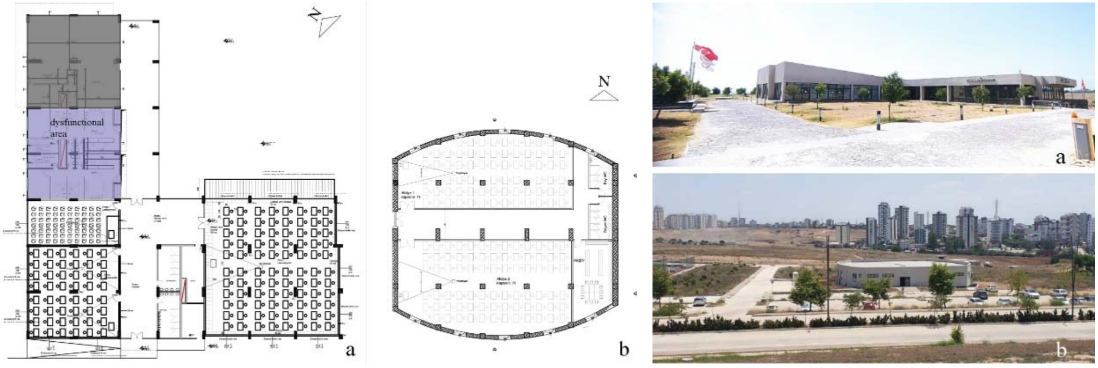


**Figure 1.** a) Plan and image of ATU Architectural Education Building 1, b) Plan and image of ATU Architectural Education Building 2 (Prepared by Author)


**Figure 2.** a) The interior of ATU Architectural Education Building 1 b) The interior of ATU Architectural Education Building 2

## Findings for Demographic Attributes

The findings for Socio-Demographic attributes of the individuals within the scope of the study are evaluated with frequency analysis and attributed as percentage frequency (Table 5).

**Table 5.** Findings for Demographic Attributes

| Variable | | n | % |
|---|---|---|---|
| Gender | Woman | 38 | 42.2 |
| | Man | 52 | 57.8 |
| Year | 1st Year | 19 | 21.1 |
| | 2nd Year | 25 | 27.8 |
| | 3rd Year | 17 | 18.9 |
| | 4th Year | 29 | 32.2 |

57.8% (n: 52) and 42.2% (n: 38) of the students are man and woman, respectively. When the year distributions are examined, 1st year students are at the rate of 21.1% (n: 19), 2nd year students are at the rate of 27.8% (n: 19), 3rd year students are at the rate of 19.9% (n: 17) and 4th year students are at the rate of 32.2% (n: 29).

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**Table 6.** Examination of Normality of Scale and Sub-Dimension Scores

| | Kolmogorov-Smirnov | | Skewness | Kurtosis |
|---|---|---|---|---|
| | Statistics | p | | |
| Visual comfort | 0.11 | 0.00 | -0.43 | -0.36 |
| Auditory comfort | 0.16 | 0.00 | -0.11 | -1.01 |
| Thermal comfort | 0.15 | 0.00 | -0.64 | -0.45 |
| Spatial comfort | 0.09 | 0.00 | -0.33 | -0.65 |
| Air quality | 0.07 | 0.06 | -0.06 | -0.80 |
| General Scale | 0.09 | 0.01 | -0.55 | -0.06 |

The fact that whether the data shows a normal distribution is decided by examining Kolmogorov-Smirnov skewness-kurtosis coefficients and histogram graphics in order to determine the analysis to be used in testing hypothesis. When Table 6 is examined, the data of which the significance level achieved by Kolmogorov-Smirnov tests is above 0.05 were considered as it shows normal distribution. In the data of which the significance level is less than 0.05, the skewness and kurtosis levels were between ±2,0 and statistical analysis was carried out by parametric tests by considering that the values did not show an extreme deviation from the normal distribution.

**Comparison of Total Scale and Sub-Dimension Scores by Demographic Attributes**

The fact that whether comfort conditions scale and sub-dimension scores differ by categorical variables is examined with Independent T-test and Anova Test. Anova analysis multiple comparison is carried out with Bonferroni's test.

The scores of visual comfort, auditory comfort, thermal comfort, spatial comfort, air quality and general comfort achieved for ATU Architectural education building -1 (AEB-1) show no significant difference statistically by the genders of students (p>0.05) (Table 7).

**Table 7.** Comparison of The Scale and Sub-Dimension Scores by Gender for ATU Architectural Education Building 1

| | Group | $\bar{X}$ ±Ss | t | P |
|---|---|---|---|---|
| Visual comfort | Man | 3.50±0.78 | 0.09 | 0.93 |
| | Woman | 3.49±0.78 | | |
| Auditory comfort | Man | 2.68±0.98 | 0.34 | 0.74 |
| | Woman | 2.62±0.98 | | |
| Thermal comfort | Man | 3.27±0.88 | -0.05 | 0.96 |
| | Woman | 3.28±0.88 | | |
| Spatial comfort | Man | 3.21±0.78 | -0.12 | 0.90 |
| | Woman | 3.23±0.88 | | |
| Air quality | Man | 3.01±0.98 | 1.55 | 0.12 |
| | Woman | 2.72±0.88 | | |
| General Scale | Man | 3.28±0.58 | 0.04 | 0.97 |
| | Woman | 3.28±0.58 | | |

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Visual comfort scores achieved for ATU Architectural education building -2 (AEB-2) show a significant difference statistically by gender of the students ($p<0.05$). It is determined that visual comfort satisfaction level of women (2.41±0.88) is lower compared to the men (2.88±1.08) when considering the mean values.

Auditory comfort scores achieved for AEB-2 show a significant difference statistically by gender of the students ($p<0.05$). It is determined that auditory comfort satisfaction level of women (2.26±1.08) is lower compared to the men (2.80±0.98) when considering the mean values.

Thermal comfort scores achieved for AEB-2 show a significant difference statistically by gender of the students ($p<0.05$). It is determined that thermal comfort satisfaction level of women (2.64±1.18) is lower compared to the men (3.14±1.08) when considering the mean values.

Spatial comfort scores achieved for AEB-2 show a significant difference statistically by gender of the students ($p<0.05$). It is determined that spatial comfort satisfaction level of women (2.31±0.98) is lower compared to the men (2.88±0.98) when considering the mean values.

Air quality scores achieved for AEB-2 show a significant difference statistically by gender of the students ($p<0.05$). It is determined that air quality satisfaction level of women (2.34±1.08) is lower compared to the men (2.83±1.08) when considering the mean values.

General comfort scores achieved for AEB-2 show a significant difference statistically by gender of the students ($p<0.05$). It is determined that general comfort satisfaction level of women (2.35±0.88) is lower compared to the men (2.87±0.88) when considering the mean values (Table 8).

**Table 8.** Comparison of the Scale and Sub-Dimension Scores by Gender for AEB-2

| | Group | $\bar{X}$ ±Ss | t | P |
|---|---|---|---|---|
| Visual comfort | Man | 2.88±1.08 | 2.37 | 0.02 |
| | Woman | 2.41±0.88 | | |
| Auditory comfort | Man | 2.80±0.98 | 2.48 | 0.02 |
| | Woman | 2.26±1.08 | | |
| Thermal comfort | Man | 3.14±1.08 | 2.04 | 0.04 |
| | Woman | 2.64±1.18 | | |
| Spatial comfort | Man | 2.88±0.98 | 2.77 | 0.01 |
| | Woman | 2.31±0.98 | | |
| Air quality | Man | 2.83±1.08 | 2.20 | 0.03 |
| | Woman | 2.34±1.08 | | |
| General Scale | Man | 2.87±0.88 | 2.86 | 0.01 |
| | Woman | 2.35±0.88 | | |

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The scores of visual comfort, thermal comfort, spatial comfort and general comfort achieved for AEB-1 show no significant difference statistically by the year level of students (p>0.05).

The scores of auditory comfort achieved for AEB-1 show a significant difference statistically by the year level of students (p<0.05). According to Bonferroni's multiple comparison test made in order to understand in which year levels the difference is found, it is determined that that auditory comfort satisfaction levels of 1st year students are lower compared to the 4th year students.

The scores of air quality achieved for AEB -1 show a significant difference statistically by the year level of students (p<0.05). According to Bonferroni's multiple comparison test made in order to understand in which year levels the difference is found, it is determined that that air quality satisfaction levels of 2nd and 3rd year students are lower compared to the 4th year students (Table 9).

**Table 9.** Comparison of the Scale and Sub-Dimension Scores by Year Level for AEB-1

| | | $\bar{X}$ ±Ss | F | p | Difference |
|---|---|---|---|---|---|
| Visual comfort | 1st Year[a] | 3.54±0.55 | 0.40 | 0.75 | |
| | 2nd Year[b] | 3.37±0.82 | | | |
| | 3rd Year[c] | 3.47±0.73 | | | |
| | 4th Year[d] | 3.58±0.74 | | | |
| Auditory comfort | 1st Year[a] | 2.37±0.96 | 3.03 | 0.03 | a<d |
| | 2nd Year[b] | 2.40±0.87 | | | |
| | 3rd Year[c] | 2.62±1.01 | | | |
| | 4th Year[d] | 3.05±0.90 | | | |
| Thermal comfort | 1st Year[a] | 3.24±0.77 | 0.32 | 0.81 | |
| | 2nd Year[b] | 3.21±0.96 | | | |
| | 3rd Year[c] | 3.19±0.92 | | | |
| | 4th Year[d] | 3.41±0.84 | | | |
| Spatial comfort | 1st Year[a] | 3.24±0.65 | 1.93 | 0.13 | |
| | 2nd Year[b] | 3.15±0.84 | | | |
| | 3rd Year[c] | 2.91±0.91 | | | |
| | 4th Year[d] | 3.46±0.66 | | | |
| Air quality | 1st Year[a] | 2.93±0.78 | 2.75 | 0.04 | b,c<d |
| | 2nd Year[b] | 2.63±1.00 | | | |
| | 3rd Year[c] | 2.53±0.74 | | | |
| | 4th Year[d] | 3.17±0.82 | | | |
| General Scale | 1st Year[a] | 3.27±0.49 | 1.77 | 0.16 | |
| | 2nd Year[b] | 3.16±0.67 | | | |
| | 3rd Year[c] | 3.13±0.57 | | | |
| | 4th Year[d] | 3.47±0.52 | | | |

The scores of auditory comfort, thermal comfort and air quality achieved for AEB-2 show no significant difference statistically by the year level of students (p>0.05).

The scores of visual comfort achieved for AEB-2 show a significant difference statistically by the year level of students (p<0.05). According to Bonferroni's multiple

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comparison test made in order to understand in which year levels the difference is found, it is determined that visual comfort satisfaction levels of the 3rd year students are lower compared to the 1st year students.

The scores of spatial comfort achieved for AEB-2 show a significant difference statistically by the year level of students ($p<0.05$). According to Bonferroni's multiple comparison test made in order to understand in which year levels the difference is found, it is determined that spatial comfort satisfaction levels of the 3rd year students are lower compared to the 1st year students.

The scores of general comfort achieved for AEB-2 show a significant difference statistically by the year level of students ($p<0.05$). According to Bonferroni's multiple comparison test made in order to understand in which year levels the difference is found, it is determined that general comfort satisfaction levels of the 3rd year students are lower compared to the 1st year students (Table 10).

**Table 10.** Comparison of the Scale and Sub-Dimension Scores by Year Level for AEB-2

| | | $\bar{X}$ ±Ss | F | P | Difference |
|---|---|---|---|---|---|
| Visual comfort | 1st Year[a] | 3.08±0.95 | 3.06 | 0.03 | c<a |
| | 2nd Year[b] | 2.64±0.95 | | | |
| | 3rd Year[c] | 2.16±0.81 | | | |
| | 4th Year[d] | 2.54±0.92 | | | |
| Auditory comfort | 1st Year[a] | 2.82±0.89 | 2.63 | 0.06 | |
| | 2nd Year[b] | 2.46±1.09 | | | |
| | 3rd Year[c] | 1.91±0.97 | | | |
| | 4th Year[d] | 2.64±1.09 | | | |
| Thermal comfort | 1st Year[a] | 3.26±1.03 | 1.25 | 0.30 | |
| | 2nd Year[b] | 2.82±1.18 | | | |
| | 3rd Year[c] | 2.54±1.28 | | | |
| | 4th Year[d] | 2.79±1.11 | | | |
| Spatial comfort | 1st Year[a] | 3.05±0.76 | 3.08 | 0.03 | c<a |
| | 2nd Year[b] | 2.46±1.00 | | | |
| | 3rd Year[c] | 2.10±0.97 | | | |
| | 4th Year[d] | 2.56±1.01 | | | |
| Air quality | 1st Year[a] | 2.96±1.06 | 1.97 | 0.13 | |
| | 2nd Year[b] | 2.36±1.00 | | | |
| | 3rd Year[c] | 2.19±1.19 | | | |
| | 4th Year[d] | 2.64±1.01 | | | |
| General Scale | 1st Year[a] | 3.04±0.79 | 3.64 | 0.02 | c<a |
| | 2nd Year[b] | 2.54±0.88 | | | |
| | 3rd Year[c] | 2.11±0.80 | | | |
| | 4th Year[d] | 2.56±0.88 | | | |

Figure 3 shows the summarized statistics of general scale and sub-dimension scores of AEB-1 and AEB-2

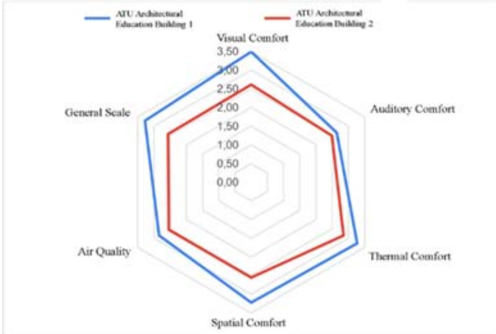


**Figure 3.** Summarized Statistics of Scale and Sub-Dimension Scores by the Groups

Table 11 expresses the differences between the scores of visual comfort, auditory comfort, thermal comfort, spatial comfort, air quality and general scale for AEB-1 and AEB-2. There is a significant difference statistically between the scores of visual comfort ($p<0.05$). When the mean values are observed, the students found AEB-1 (3.49±0.72) better concerning visual comfort compared to AEB-2 (2.61±0.95).

There is a significant difference statistically between the scores of thermal comfort achieved for AEB-1 and AEB-2 ($p<0.05$). When the mean values are observed, the students found AEB-1 (3.28±0.87) better concerning thermal comfort compared to AEB-2 (2.85±1.15).

**Table 11.** Comparison of the Scale and Sub-Dimension Scores for AEB-1 and AEB-2

| | Group | $\bar{X}$ ±Ss | t | p |
|---|---|---|---|---|
| Visual comfort | ATU architectural education building 1 | 3.49±0.72 | 7.01 | 0.00 |
| | ATU architectural education building 2 | 2.61±0.95 | | |
| Auditory comfort | ATU architectural education building 1 | 2.64±0.95 | 1.04 | 0.30 |
| | ATU architectural education building 2 | 2.49±1.06 | | |
| Thermal comfort | ATU architectural education building 1 | 3.28±0.87 | 2.78 | 0.01 |
| | ATU architectural education building 2 | 2.85±1.15 | | |
| Spatial comfort | ATU architectural education building 1 | 3.22±0.78 | 5.08 | 0.00 |
| | ATU architectural education building 2 | 2.55±0.99 | | |
| Air quality | ATU architectural education building 1 | 2.85±0.88 | 2.07 | 0.04 |
| | ATU architectural education building 2 | 2.54±1.07 | | |
| General scale | ATU architectural education building 1 | 3.28±0.58 | 6.36 | 0.00 |
| | ATU architectural education building 2 | 2.57±0.88 | | |

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There is a significant difference statistically between the scores of spatial comfort achieved for AEB-1 and AEB-2 ($p<0.05$). The students found AEB-1 (3.22±0.78) better concerning spatial comfort compared to AEB-2 (2.55±0.99) when considering the mean values.

There is a significant difference statistically between the scores of air quality achieved for AEB-1 and AEB-2 ($p<0.05$). The students found AEB-1 (2.85±0.88) better concerning air quality compared to AEB-2 (2.54±1.07) when considering the mean values.

There is a significant difference statistically between the scores of general comfort achieved for AEB-1 and AEB-2 ($p<0.05$). The students found AEB-1 (3.28±0.58) better concerning air quality compared to AEB-2 (2.57±0.88) when considering the mean values.

## DISCUSSION

When the findings achieved from the two education buildings that are examined through the scale that was developed within the scope of the study;

In the visual comfort dimension, it is found that the satisfaction level in AEB-2 (2.61±0.95) is lower regarding to AEB-1 (3.49±0.72) (Figure 4). The reasons of a significant difference between the two values may include the facts that AEB-1 has more facilities of natural lighting, the window sizes are larger and the opening ratios are more compared to AEB-2. It can be concluded that, due to the similar attributes of artificial lighting elements in both buildings, they do not have an effect on the satisfaction level.

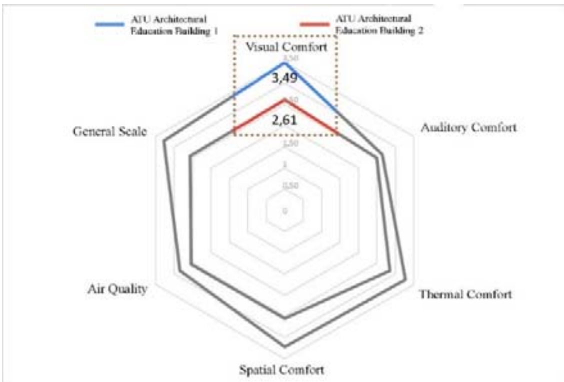


**Figure 4.** Visual Comfort Scores by the Groups

In auditory comfort dimension, there is no significant difference between the AEB-1 (2.64±0.95) and the AEB-2 (2.49±1.06), but it is understood that both buildings have low satisfaction levels in the relevant dimension (Figure 5). This may result from the fact that HVAC systems preferred for climatization in the spaces/studios in the buildings operate noisy in both buildings and acoustics of studios/classrooms are not suitable for the function.

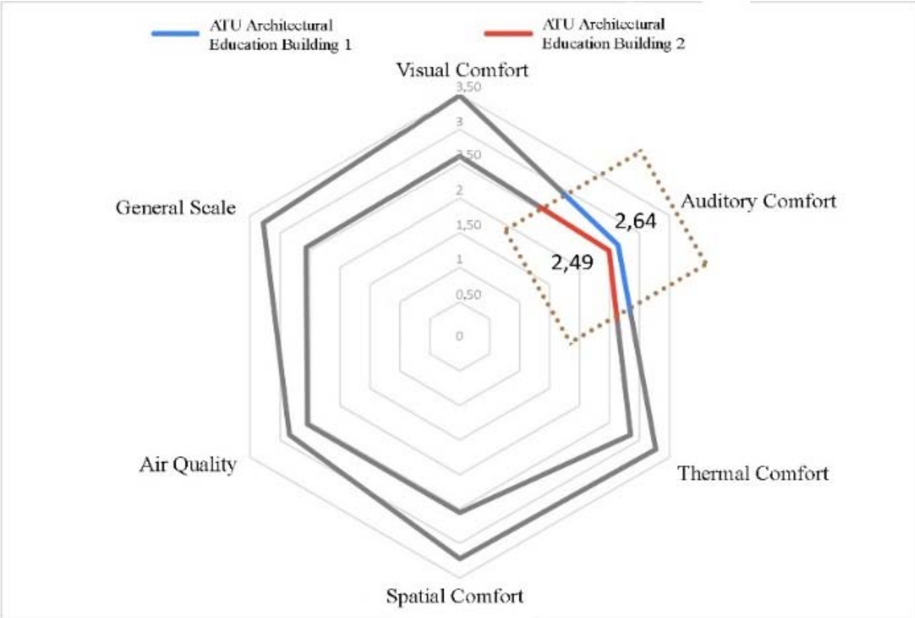


**Figure 5.** Auditory Comfort Scores by the Groups

In thermal comfort dimension, it is observed that satisfaction level in the AEB-2 (2.85±1.15) is lower compared to satisfaction level in the AEB-1 (3.28±0.87) (Figure 6). It is considered that the fact that the types of climatization types preferred in the buildings are different in the buildings and that passive acquisition differences brought by the building designs are effective in the significant difference between thermal comfort satisfaction levels of the two buildings. It can be said that, thanks to the design and form of the AEB-1, heating is especially maintained passively in the building. The facts that there are many glass surfaces, solar rays are received more into the building, passive heating is maintained, and orientation is effective in the positioning of building are effective in heating spaces especially in winter season. On the other hand, in the AEB-2, in the south façade which is very important in passive heating, passive acquisition in heating cannot be maintained sufficiently due to the insufficiency of opening/window (there are only very thin ribbon windows which have the nature of sunroofs). Therefore, heating that will be obtained from mechanical heating systems is needed more in the AEB-2 compared to the AEB-1. Nevertheless, the mechanical systems also fail to satisfy in heating and in cooling in the building due to the fact that freestanding split air-conditioners are preferred in the AEB-2. Furthermore, the facts that the studios are large and the air-conditioners are located at the far points of the studios lead to the failure of maintaining homogenous airflow and, make the device controls/settings difficult. Therefore, it is revealed that the selections of HVAC system to be used especially in the AEB-2 and the internal unit placements should be made in accordance with the building and the spaces in the building.

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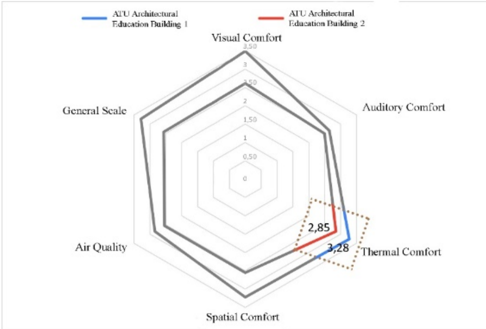


**Figure 6.** Thermal Comfort Scores by the Groups

In spatial comfort dimension, it is understood that satisfaction level in the AEB-2 (2.55±0.99) is lower than satisfaction level in the AEB-1 (3.22±0.78) (Figure 7). It can be said that the facts that space organization of the AEB-1 is better compared to the AEB- 2 and there are columns just in the middle of the studios in the AEB-2, the fixed reinforcements, mobile reinforcements and preferred materials in the AEB-1 are better and of better quality, the AEB-1 has more facilities as the use of common areas except for studios/classrooms and has a stronger relationship with the other buildings in the campus are effective in the significant difference between spatial comfort satisfaction levels of the two buildings.

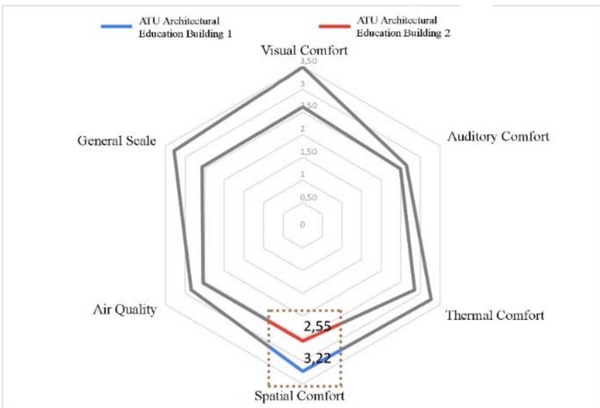


**Figure 7.** Spatial Comfort Scores by the Groups

In air quality dimension, it is observed that satisfaction level in the AEB-2 (2.54±1.07) is lower than satisfaction level in the AEB-1 (2.85±0.88) (Figure 8). It can be said that the fact that natural ventilation facilities and accordingly, fresh air supply facilities in the AEB-2 are less compared to the AEB-1 is effective in the significant difference between air quality satisfaction levels of the two buildings. If an evaluation is made within the

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context of provision of natural ventilation, when the openings in the façades of the AEB-2 and the circulation types required by fresh airflow are taken into account, it is observed that placement and location of the windows/openings fail to satisfy compared to the AEB-1. When it is examined only for air quality dimension, it is found that satisfaction values of both buildings are low. Its reason can be specified as the solid waste facility situated near the campus and the bad smells spreading in certain periods.

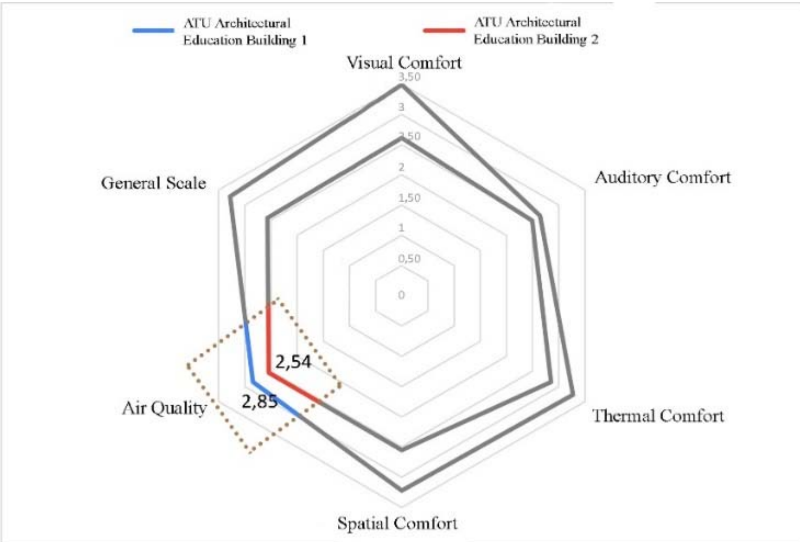


**Figure 8.** Air Quality Comfort Scores by the Groups

In the general framework, general satisfaction level in the AEB-2 is lower compared to the AEB-1. On the other hand, in the satisfaction comparisons made by gender, while there is no significant difference in the AEB-1, it is concluded that satisfaction level of women is lower than the level of men in the AEB-2. In the comparisons made by year levels, there are significant differences for both buildings, but it can be said that the mentioned differences are not suitable for making a senior-junior level comparison. Different and independent results are obtained for the different dimensions in the findings achieved through the year levels.

## CONCLUSION

The literature review shows that there is a need for a more holistic and collective user satisfaction understanding within the context of comfort conditions. The scale, which is developed in this context, comprises of five dimensions as visual comfort, auditory comfort, thermal comfort, spatial comfort and air quality. Each dimension in the scale includes indicators to realize the relevant dimension in practice. The important indicators that are effective in user satisfaction in visual comfort dimension become prominent as natural lighting, artificial lighting, and equipment selected for

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artificial lighting and artificial lighting elements with sensors. In auditory comfort dimension, the indicators of sounds originating from internal and external units of HVAC (heating, cooling, ventilation) systems and acoustics of studios/classrooms are important criteria in user satisfaction. In thermal comfort dimension, heating level and balance of spaces, cooling level and balance of spaces, heating/cooling level and balance of building common areas and control systems of heating/cooling equipment are the factors affecting user satisfaction. In spatial comfort dimension, space organization and indoor space design, layout, dimensions, quality of fixed reinforcements, doors/windows and fixtures used in wet areas, layout, dimensions and quality of mobile reinforcements, availability of the building to work at all hours (day/night) and common areas in the building are important indicators; while in air quality dimension, fresh air amount indoors provided by natural ventilation, dry air circulating inside, air pollution-related smells, smell of materials, toilet and dampness smells become prominent as the factors to be considered in providing user satisfaction.

As a result of the analysis made in the study, the principal dimensions and sub-indicators of the scale that was developed in order to evaluate the user satisfaction in the education buildings on comfort conditions are found satisfactory concerning their rates for describing the phenomenon which is asked to be measured. It is concluded that each evaluation proposition in the scale can distinguish well those which have and have not the attribute that is asked to be measured by this proposition and the scale is found to be suitable for its intended use. It is understood that the comfort conditions scale can directly determine the dimensions that are taken into account in the education buildings to which it will be applied, and that it can reveal the neglected dimensions and indicators in the examined processes.

## RECOMMENDATIONS

It is confirmed that the comfort conditions scale is at a level that can distinguish user satisfaction/dissatisfaction thanks to the analysis and the case study. The scale can be used for not only post-use evaluation and development in the use/operational process of education buildings, but also has the potential to be used in the planning and design stages. It is suggested and anticipated to be beneficial for guiding design and application processes of the education buildings, as it will help planners/stakeholders to consider in advance how to integrate comfort conditions dimensions and indicators into the process thanks to its principal dimensions and sub-indicators.

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