The Turkish Online Journal of Design, Art and Communication

E-ISSN: 2146-5193

DOI: 10.7456/tojdac

Research Article / Araştırma Makalesi

SUDDEN TRANSITION FROM PHYSICAL TO DIGITAL: COLOR LEARNING IN ARCHITECTURAL EDUCATION DURING THE COVID-19 PANDEMIC

FİZİKSELDEN DİJİTALE ANİ GEÇİŞ: COVID-19 PANDEMİSİ SIRASINDA MİMARLIK EĞİTİMİNDE RENK ÖĞRENİMİ

İlayda SOYUPAK[1]

ORCID: İ.S. 0000-0002-3770-420X

Corresponding author/Sorumlu yazar:
İlayda Soyupak
Marmara University, Turkey
E-mail/E-posta: ilaydasoyupak@gmail.com

Received/Geliş tarihi: 07.01.2025

Benzerlik Oranı/Similarity Ratio: %8

Revision Requested/Revizyon talebi: 02.02.2025

Last revision received/Son revizyon teslimi: 13.03.2025

Accepted/Kabul tarihi: 15.03.2025

Etik Kurul İzni/ Ethics Committee Permission: Duzce University Ethics Committee 2020 - 129 / 2020

Citation/Atıf: Soyupak, İ. (2025). Sudden Transition From Physical To Digital: Color Learning In Architectural Education During The Covid-19 Pandemic. The Turkish Online Journal of Design Art and Communication, 15 (2), 377-393. https://doi.org/10.7456/tojdac.1614849

Abstract
COVID-19 pandemic enforced all disciplines to sudden change in their education methods. As having a practice-based education methodology, architecture education necessitated creative ways to overcome this critique change. This qualitative study searches for the ways to deliver a physical concept, color, within a non-physical setting, and explores the effectiveness of color studies in distance architectural education in COVID-19 Pandemic period. This study specifically focuses on how asynchronous distance education affected the color knowledge and learning in architecture education. In this study, the effectiveness of the color course in terms of architecture and design education is evaluated according to its impact on gaining knowledge about basics of color theory, understanding color and material combinations and emotional associations on those combinations, gaining skills in shaping individuals' interior space experience, covering the potential of various color practices. This study is an action research and assignment outputs, self-assessments of participating students' work, visuals of the submissions, and observations made by the researcher are the main data sources of this study. The study revealed the importance of using various communication methods to fully capture the concept of color in architectural education and pointed out the positive aspects of hybrid education.

Keywords: Architecture, Education, Distance Learning, Color Course, Color Communication

Öz
COVID-19 pandemisi tüm disiplinleri eğitim yöntemlerinde ani bir değişime zorladı. Uygulamaya dayalı bir eğitim metodolojisine sahip olan mimarlık eğitimi, bu kritik değişimin üstesinden gelmek için yaratıcı yollar gerektirmiştir. Bu nitel çalışma, fiziksel bir kavram olan rengi fiziksel olmayan bir ortamda sunmanın yollarını aramakta ve COVID-19 Pandemisi döneminde uzaktan mimarlık eğitiminde renk çalışmalarının etkinliğini araştırmaktadır. Bu çalışma özellikle asenkron uzaktan eğitimin mimarlık eğitiminde renk bilgisi ve öğrenimini nasıl etkilediğine odaklanmaktadır. Bu çalışmada, renk dersinin mimarlık ve tasarım eğitimi açısından etkinliği, renk teorisinin temelleri hakkında bilgi edinme, renk ve malzeme kombinasyonlarını ve bu kombinasyonlardaki duygusal ilişkilendirmeleri anlama, bireylerin iç mekan deneyimini şekillendirmede beceri kazanma ve çeşitli renk uygulamalarının taşıdığı potansiyeli kavrama üzerindeki etkisine göre değerlendirilmektedir. Bu çalışma bir eylem araştırmasıdır ve ödev çıktıları, katılımcı öğrencilerin çalışmalarının öz değerlendirmeleri, sunumların görselleri ve araştırmacı tarafından yapılan gözlemler bu çalışmanın ana veri kaynaklarını oluşturmaktadır. Çalışma, mimarlık eğitiminde renk kavramını tam olarak yakalamak için çeşitli iletişim yöntemlerinin kullanılmasının önemini ortaya koymuş ve hibrit eğitimin olumlu yönlerine işaret etmiştir.

Anahtar Kelimeler: Mimarlık, Eğitim, Uzaktan Eğitim, Renk Eğitimi, Renklerle İletişim

INTRODUCTION

Architectural education is formed of theoretical and practical knowledge articulation within its own cultural setting. Basically, it is about improving architectural thinking by experiencing design elements such as form, material, color, structure; and paying attention to environmental and social values. Each design element is equally important in the formation of an architectural composition and in the interaction between the people and the architectural work. Therefore, in addition to architectural design studios, the concept of color, as with other design elements, is often studied as part of a special course in the architecture curriculum. The architectural color courses mainly involve comprehension of the effects of color in an architectural composition via a set of experiments. In these courses, color studies are discussed in the same physical settings by students. However, during Covid-19 pandemic, due to the enforced distance education, a sudden transition from physical to digital educational setting altered the way of interaction in color courses. Ensuring the effectiveness of color studies in distance architectural education was seen as a problem and within this framework solutions were planned and executed in this study. This study proposes several digital exercises; and evaluates them in terms of their effectiveness in comprehending color, emotion, material and spatial relationship in distance architectural education. It evaluates the potential of these exercises in four aspects of color and architecture relationship:

1) comprehension of controlling reflected emotions through color and material combinations;
2) altering the experience of the interior space by changing the color;
3) facade color design, and
4) using external sources in creating color combinations to manage color and space relation.

The Reasons to Study Color in Architecture

Architecture creates environmental experiences and deals with mass within a function-focused perspective by accounting of every design element (Rasmussen, 1964). Color is an extrovert member of architectural design; it constantly interacts with other environmental elements and humans. Thus, by considering all these elements, it is possible to manage the spatial experience of an individual in any building. In interaction with humans, color delivers the symbolic messages and aesthetic qualities of the environment (Meerwein, Rodeck, & Mahnke, 2007). Being highly dependent on the values and qualities of its surrounding environment, and its inhabitants, the color in architecture demonstrates case specific characteristics. Its symbolic and social nature makes it hard to form a universal set of color rules in architecture (Cesar, 2018). Color is the combination of perception, culture, experience, memories (Manav, 2017). So, the person dependent aspect of color leads to a variety of interpretations of architectural color arrangements. Individuals interact with colors in a manmade environment within their way of thinking which is shaped through their life. The studies of Kaya & Crosby (2006)), and Manav (2007) also point to close relationships between color associations and personal experiences. The subjective essence of the color does not inhibit the potency and efficacy of color combinations in architectural designs, on the contrary it improves them (Manav, 2017).

In architectural compositions color applications can be used for their perceptive, descriptive or intrinsic values (Serra, 2013a). Color applications in architectural designs alter both the perception of the building by an individual and general perception of the urban. In urban scale, the combination of differing colors of buildings constitutes the color scheme of a city and affects the urban perception. However, this visual character is not solely to be understood as the hues of the city. Color preferences of a building can be seen as mirrors. It reflects both physical and abstract characteristics of their time and society. As underlined in the studies of Serra and Codoner (2014), and Ferring (2014) values and tendencies of a time and culture can be traced by architectural color compositions. In example, powerful hues of Mexican everyday life can easily be traced in Ricardo Legorreta's architectural designs and the color choices of him intensify the spatial experiences of users (Asensio & Kliczkowski, 2002). Similarly, Mexican architects Luis Barragan attaches cultural cues to his contemporary architectural designs and applies color after on-site spatial experiments to comprehend the spatial experience in an ordinary day setting (Jover & Alba, 2002) . Difference in demographic structure and cultural background affects the urban color and creates diversity in the cities' appearance (Gou & Wang, 2017). Color is a very effective and easily managed medium of change in architecture. Serra (2013) draws attention to color applications' suitability for the versatile essence of architecture, and its potential power in change in terms of

transformation, fragmentation, movement and novelty. Architectural adaptation to changing inhabitants, functions, actions, time and technology can easily be created with the suitable application of new color arrangements.

Color in Architectural Education

Being rooted in apprenticeship, architectural education built upon required abilities and values of the profession (Glasser, 2000). Erkök et al. (2006) proposes that at the basic design studio, in transition from abstract to physical thinking, students experience key concepts of architecture; and color is one of these key concepts. Color usage in architecture requires synthesis of subjective and objective decision making. So, at the basic design studio, students improve their ability to use color in a targeted manner (Ural, Akbay, & Altay, 2002). And, in the following design studio courses, students reinforce their color knowledge through architectural design projects. Beside the basic design studio, the following design studio courses mostly do not involve solely color specific exercises. However, as Unver (2002) stated, in addition to basic design studio, color takes its place in other compulsory courses related with design communication, and there are some elective courses specifically focused on color in architecture. Parallel to the impact area of color in architecture, content of the specified color courses is expected to deliver the theoretical, practical and social context of color by application of different methods by using physical and digital tools (Unver, 2002; Carlos & Cesar, 2018). Applications of different methods are parts of color research, and they are highly important in color education since color concept is dependent on experience. However, the previous studies in color education in architecture (Carlos & Cesar, 2018; Janssens & Mikellides, 1998) show the insufficient duration of color courses in terms of both theoretical and practical context of color; and point to lack of knowledge of architecture graduates in color usage (Janssens & Mikellides, 1998; Csillag et al. 2018). Proper development of architectural way of thinking necessitates equal inclusion of every design parameter in the educational curriculum.

Distance Education in Architecture

Being able to continue education without face-to-face interaction is the essential aspect of distance education. Gunawardena and McIsaac (2013), highlights the long existence of distance education, and within the light of the study of Garrison and Shale (1987), underlines the essential features of the distance education as *noncontiguous communication, two-way interactive communication, and the use of technology to mediate the necessary two-way communication.* Technology involvement in distance education makes people believe it as a new method, but the new is the technologic medium, not the method itself. Therefore, distance education in architecture is not a new concept, and there have been trials to adapt new technologies to architecture and design education long before the COVID-19 pandemic. Inevitably, practical essence of architecture discipline was causing resistance and decreasing the speed of permeation of distance learning in architectural education. Ceylan et al. (2021) explains that there were already searches (by Morozumi et al., 2001; Niculae, 2011; Schnabel and Ham, 2012; Masdeu and Fuses, 2017; Iannou, 2018) for new ways of design studio by implementing blended learning, distant education or virtual studio methods. However, COVID-19 pandemic caused an urgent and mandatory change in traditional educational methods in global scale.

Depending on its sudden occurrence, some researchers categorize this large-scaled shift to online learning from the existing distance education methods and it is particularly emphasized that distance learning during COVID-19 pandemic was born in crisis and in an emergency (Adedoyin & Soykan, 2023; Akçay Kavakoğlu et al., 2022). Globally, most of the syllabuses and term plans were not tailored for online interaction. Since this study is also related with the educational action in color teaching during COVID-19 pandemic, it would be appropriate to focus distance architecture and design education the pandemic times and analyze potentials and challenges that were underlined in other studies. In many of the studies; self-paced learning, developing time management skills, meeting new online platforms, flexibility, special focus to each student's work, positive economic impacts, strength of online studio, sustainability were found as positive outcomes of this sudden shift in architecture and design education (Alfiras et al., 2020; Daniel, 2020; Alburgawi and Al-Gamdi, 2022; Megahed and Hassan, 2022; Amro, 2022; Fallatah, 2020; Hassanpour, 2023; Ceylan et al., 2021; Iranmanesh and Onur, 2021; Lotfabadi and Mousavi, 2022; Martesonjoyo, 2021; Nigam and Kapoor; 2021). In addition to positive critiques,

lack of peer learning, not being part of design studio collective, challenges in interaction, inequality in accessing technologic sources, insufficent distance education infrastructure of the educational institutions, interface problems, inexperience in using technolgy, student's workload, difficulty in groupwork, adaptation to new space for education, not knowing peers' works, extra effort, different time zoning were explained as the main challanges in this process (Alfiras et al., 2020; Allu-Kangkum, 2021; Alburgawi and Al-Gamdi, 2022; Brzezicki, 2020; Ceylan et al. 2021; Fewella, 2023, Yuan et al. 2022; Grover & Wright, 2023; Lotfabadi and Mousavi, 2022). Most of the studies that explored the effects of Covid-19 pandemic on architectural and design education has design studio focus. In that sense, peer learning and cumulative knowledge gained in the studio have spacial importance as can be followed from the results of the literature research on this issue. For the last, it should be mentioned that positive aspects of hybrid architectural education for post-pandemic term is highly emphasized, and high rate of demand for it, by both students and tutors, is underlined in the studies (Gill et al., 2020; Ceylan et al., 2021; Iranmanesh and Onur, 2021; Nigam and Kapoor; 2021)

METHODOLOGY

To adopt the architectural color education to a new environment, the researcher needed to consider systematic changes as a reflective practitioner (Schön, 1987; Norton, 2018). In that sense, this study stands as action research which inquires for ways of enriching teaching strategies and development of students' knowledge (Stringer, 2008). Kowaltowski et al. (2020) points to the similarity between the cyclical nature of the action research and the iterative cycle of design processes. In line with that, at the very beginning of the pandemic, as having a design background, the researcher intuitively defined the possible problems in enforced shift to distance education in terms of architectural color education and created an action plan to defeat the possible negative outcomes of the process. In order to analyze the problem adequately, it was necessary to look for the pre-pandemic conditions and the pandemic conditions and set the differences between these two. Elliot (1991) stress the importance of curriculum structure on any action taken for improving learning experiences. In that sense, initially, curriculum of the Düzce University Department of Architecture, the impact and placement of the Color in Space course was analyzed. All the courses were dependent on face-to-face interaction, and there weren't any other color related courses in the curriculum besides the first semester foundation studio in pre-pandemic period. So, to make students comprehend the impacts of color, the researcher had planned to combine color theory with the architecture design studio related practical studies through 2D and 3D, different scaled compositions. In the initial stages of the pandemic time, asynchronous education was deployed, and the researcher altered the planned practical studies. Main problem was finding ways to transmit a physical concept, color, without physical settings and in the lack of instant communication in asynchronous education. At the very beginning of the pandemic time, of course the type or credits of the course did not change, but interaction level and weight of the course in the curriculum were equalized with the other courses because of the asynchronous delivery of all courses. So, the researcher revised the course content in accordance with this delivery method and took new actions. Improving comprehension of basics of color theory, experiencing the color and material combinations and understanding their relationship with emotions, the interior space experience guiding skills through color and material change, and exploring the potential of color in architectural compositions were the main targets of the course; and remained the same along the research process. On the other hand, planned actions were revised weekly according to the submission qualities of the students.

Within this process, to evaluate the effectiveness of newly proposed actions on learning of color in architecture and design, personal or episodic artifacts of the participant students such as assignment outputs, students' self-assessment of their works, visuals of the submissions, the researcher's observations were used as data collection tools (Efron & Ravid, 2019).

The following sections include the details about the research field, participants, data sources and data collection procedures. In this study, to comprehend the effects of applied color exercises, thematic analysis is used to segment and categorize the collected textual and visual data (Given, 2008).

Research Field and Participants

This study was carried out through two hour long theoretical elective course named as MMR 322-Color in Space at Düzce University, Department of Architecture in 2019-2020 / Spring Semester. In Turkey, undergraduate level architecture education consists of eight semesters, and in Düzce University Department of Architecture undergraduate program, MMR 322-Color in Space course is offered in the sixth semester. Students of the course participated in the study voluntarily. For 2019-2020 / Spring Term, 39 students enrolled into the course and 35 of them attended regularly. Although, in total 39 students enrolled into this course, as expected in an educational context, not all of the students completed each task. So, the participant number of each exercise differs from each other, and it is usually less than the total number of participants.

An education period at Düzce University consists of 14 weeks. In the 2019-2020 / Spring Term, the first four weeks of classes were conducted with face-to-face education. Then a mandatory three-week break was given due to COVID-19 Pandemic restrictions. After the break, the education method was shifted from face-to-face education to asynchronous distance education. In the asynchronous period, the researcher prepared each weeks' content by carefully analyzing the previous week's submissions and shared her comments both in weekly presentations and weekly videos that were uploaded to the system. To provide a systematic approach and to mimic the face-to-face weekly schedule, videos and presentations were shared with the students almost always at the same day of the week, and various digital exercises were followed.

Data Sources and Data Collection Procedures

In the course, architecture and design education specific color assignments were carried out after introducing color and light concepts, perceptible characteristics of color such as hue, saturation, colorfulness, value, lightness, brilliance (Agoston, 2013), types of color contrast (Itten, 1970) and color harmony methods. This theoretical introductory part also included several practical coloring exercises about color wheel, color contrast and color harmony. At first, students were able hang their works on the wall and discuss about their color wheel, color contrast and color harmony exercises at regular class hours in a physical setting. Following assignment categories were planned for asynchronous education.

Color, material and emotion relationship focused assignments

To examine the relationship between color, material and emotion, a series of assignments was carried out. In the first assignment, it was aimed to convey how different material characteristics affect color perception. So, each student was asked to find at least 20 material samples that share the same hue. In most cases materials from similar hues were shared. Before the pandemic regulations, students were able to physically examine color and material samples and discuss how the opacity, roughness and glossiness of the material changes the people's approach to the same color.

In the second assignment, the students were introduced to Paul Ekman's (1973) identification of six basic universal emotions and Robert Plutchik's (2001) emotion wheel, and then discussed colors and their emotional connotations in the same physical environment. Thus, they gained the idea of different emotion theories.

In the third assignment, it was aimed to show the importance of assessing the relationship between object and emotion from a holistic perspective, rather than focusing on only one aspect of design including color. This part coincided with the time when asynchronous distance education began. Via lecture notes, the students were informed about Robinson's study (2008) which includes the classification of emotions associated with stimuli from the object. Then, regarding Robinson's study (2008), students were asked to prepare two A5 size compositions reflecting one positive one negative emotion by using the same colors. 31 students uploaded their work to the system. After that, 21 students criticized the compositions of their friends through an online survey. Thus, students were able to understand the potency of design characteristics and to evaluate if the designer could lead the relationship between object and emotion relation.

Interior Color Focused Assignments

Depending on the importance of color choices in creating meaning of the interior, various exercises were executed. Students were asked to propose at least 3 alternative color and material applications to the round HSS steel structure based, non-uniformly curved stair Addition the Art Gallery of Ontario designed by Frank Gehry (Boake, 2013). In this assignment, students were free to use digital and physical tools. Most of them chose to apply new color and material to the stair by digitally manipulating an existing photo of the space. Some of them at first created 3D model and searched for alternatives (Figure 1) and then applied their decision on a web-based photo of the gallery. Following the upload process, all the works were gathered by the researcher and grouped according to their color and material choices. This document was then shared with the students via the university's system, and students were asked to write down one-word comments on the document to reflect what they thought about the new colors of the staircase. For the last, student's comments were brought together and shared with the students as word clouds near visuals of their works. Students were encouraged to analyze their friends' approach to different color alternatives of the staircase. After this stage, students revised their initial submission regarding their friends' comments and proposed final color and material interventions for the staircase.

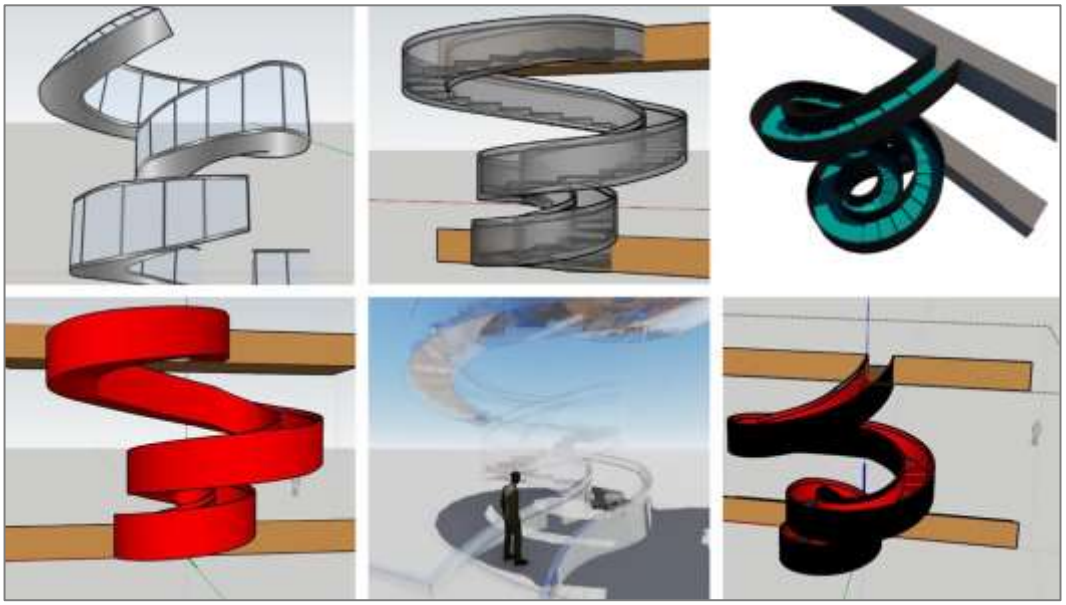

Figure 1. Some of the student works from material and color intervention assignment on an interior element

Facade Color Design Assignments

For facade color exercise, at first students were introduced with how the monochromatic, achromatic and multichromatic facade designs (Glasner & Schmidt, 2010) differ from each other, what changes, and after that they were asked to create their own facade design proposals. In this exercise, facade design of Düzce University Faculty of Forestry building was determined as the research subject, depending on the fact that participating students were taking their courses on that building before the restrictions, and they were familiar with the surrounding environment and the building's usage. The students suggested varying monochromatic, achromatic and multichromatic facade design by using photo manipulation software.

Quest for Color Scheme Creation and Color Harmony Assignment

In the course, many methods were introduced, and exercises related to these methods were carried out to reinforce the students' understanding of color knowledge and color harmony. At the end of the course, 6 weeks long, multilayered study was performed to realize the potential of external sources in the development of color sense. Students opted for an artwork from a group of paintings that was determined before by the researcher. Artworks had open access via google arts and culture website. After the

analysis, students were asked to pixelate the artwork and then create a color scheme from the pixelated version of the artwork. After that step, they applied the determined color scheme on the outer surface of İzmir Silos of Turkish Grain Board, by using photo manipulating software. İzmir Silos of Turkish Grain Board was chosen for its central location and dominant nature of the building. Photos of İzmir Silos of Turkish Grain Board was taken by the researcher and delivered to the students.

FINDINGS

Controlling Reflected Emotions Through Color and Material Combinations

Within the scope of this research, effects of color and material combination on a person's emotions were studied with various exercises. In the first exercise, students explored the effect of opacity, roughness, glossiness and they created different material and color combinations and discussed together all the course time. In this process, the researcher observed that at first, they had strict emotional associations with colors; however, they discovered with surprise that a plushy indigo sample was creating more positive emotional attachments than a shiny warmer colored metal sample.

In the second exercise, students were participating in the group discussions about emotion theories with more interest because they were able to see their friends' facial expressions while they were talking about emotions and colors. On that stage, the researcher observed that Plutchik's emotional wheel caused confusion for some students. Some students tried to associate the mentioned emotion and background color of it in the visual presentation of the wheel and did not agree with the color choice of the emotion. For example, one of the students mentioned "How green can be related to fear or terror!".

In the third exercise, they created two different (one positive one negative) emotion associated compositions regarding Robinson's (2008) emotion segmentation related with objects properties. Robinson (2008) categorizes positive emotions into three subgroups as 1) interest, curiosity; 2) attraction, desire, admiration; 3) surprise, amusement. And similarly, Robinson (2008) categorizes negative emotions into three subgroups as 1) alarm, panic; 2) aversion, disgust, revulsion; 3) indifference, familiarity, habituation. In total 31 students created compositions; and delivered to the researcher by using university's system in asynchronous education. After that researcher gathered their compositions and formed a survey to measure all participant students' compositions and emotion association levels. Survey results showed that even though there was a lack of tactile experience with the compositions, most of the students' compositions were successful to differentiate positive or negative association. And a few of them managed to reach their targeted emotion association only through presenting visuals of them. However, it should be noted that, for the last exercise (emotion and object properties relation evaluation), depending on the essence of the distance education, tactile characteristics of the compositions were not fully grasped by the students. They evaluated the compositions under different lighting conditions, from different screens, in different environmental settings and participants' previous experiences with materials in the compositions might have helped to fulfill lack of tactile interaction with the offered compositions. Thus, results might show differences if participants experience the compositions in the same physical and environmental settings.

Altering The Experience of the Interior Space by Changing the Color

In interior color intervention exercise, while some of the students focused only on color change, others examined the effects of different materials. In addition to color and material interventions, some students tried to change the function of the stairs and suggested new experiences on it. At this stage, the outputs of the submissions were divided into groups by the researcher according to color, material and experience differences; and then the students commented on these groups. While generating the subgroups, material focused interventions also were divided into the subgroups according to their distinctive features of the color. Natural stone, wooden and glass alternatives are the most common ones that students proposed for the staircase. Other than these material focused alternatives, in terms of color change, students tried red more than other color alternatives.

In their comments, students mostly criticized new color and material proposals by using adjectives and descriptive phrases. To evaluate the students' approaches to the alternative color application of an interior element, focused codes were formed by the researcher. Students' comments were analyzed

through two different code clusters generated from the studies of Horiguchi and Iwamatsu (2018) and Gao et al. (2007). The first code cluster was generated in accordance with the main words from the unofficial translation of Kobayashi's "Word Image Scale" by Horiguchi and Iwamatsu (2018). The scale is related to Kobayashi's (1981) "Adjective Image Scale". The main reason for choosing this scale as a source of code is that in asynchronous education, students were able to reflect their comments about the newly colored staircase only by writing the words. In this scale, as being developed for product planning, value attributes are reflected through using adjectives, and the subgroups that share similar attributes are placed in between warm-cool and soft-hard axes (Horiguchi and Iwamatsu, 2018). These subgroups are *dynamic, gorgeous, wild, classic, classic & stylish, stylish, chic, formal, modern, cool casual, clear, natural, romantic, elegant, pretty, casual*; and form the first code cluster in this study. Students' comments to each material and color group were analyzed through these codes, and frequency level of each code for different material and color is shared in Figure 2.

The analysis of material and color interventions within the context of the "Word Image Scale" (Horiguchi & Iwamatsu, 2018; Kobayashi, 1981) suggests that, overall, students perceive the new compositions similarly to their peers. However, a closer examination reveals interesting insights when cases are considered individually. For example, it has been revealed that impacts of glass usage for rails and for steps were different. While the transparent characteristics of the rail mostly created positive impacts and help the staircase being described mostly with clear and dynamic categories related words, transparent steps were found more impressive, strong and thrilling, thus its gorgeous characteristics perceived more dominant than its clear characteristics. In addition to that, metal interventions showcased a distinction between cold and warm characteristics, influencing students' perceptions. Also, the wooden interventions demonstrated the manipulative power of using different tones of the same material. Experience-focused interventions were perceived as dynamic compositions, with notable emphasis on casual and modern values.

The second code cluster was generated from the study of Gao et al. (2007) and contains twelve pairs of color emotional words as *soft - hard, deep - pale, gaudy - plain, warm - cool, passive - dynamic, strong - week, striking - subdued, vivid - sombre, turbid - transparent, vague - distinct, heavy - light, light - dark*. Similarly, to the first code cluster, students' comments to each material and color group were analyzed through these codes, and frequency level of each code for different material and color is shared in Figure 3. Twelve adjective pairs from the study of Gao et al. (2007) reflect the distinctive color emotion attributes of an object. Accordingly, when the students' responses are analyzed through this framework, diversity in color emotion traits stands out for each material and color composition group. Results of this analysis carries similarities with the first one. For example, glass usage in the new compositions shows slightly different impacts on students depending on its placement. Or the striking properties of both cold and warm metal interventions were almost equally highlighted, but warm colored metal compositions were found to be more dynamic while the cold one was found to be more distinctive.

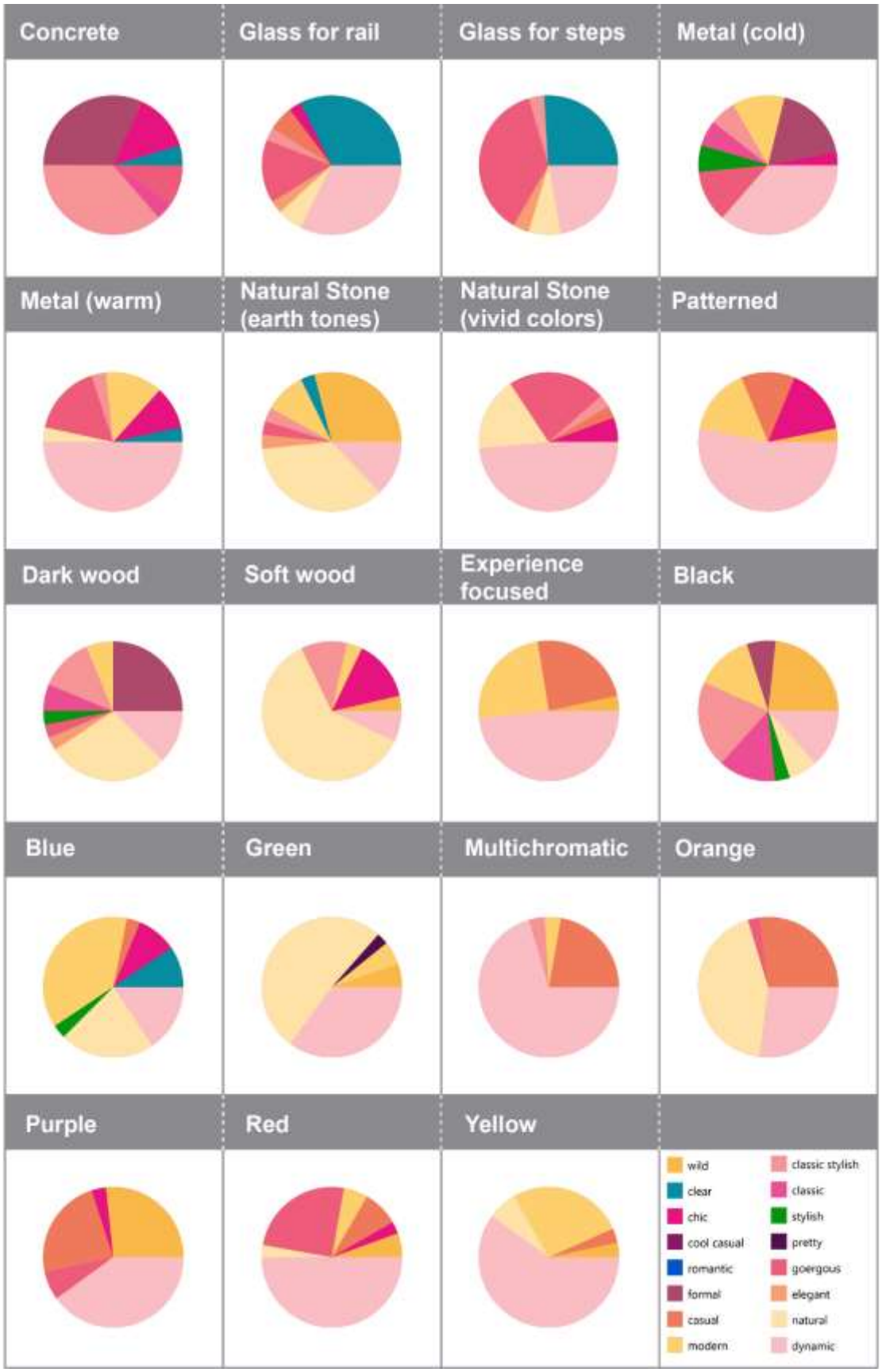

Figure 2. Frequency levels of the codes generated from the study of Horiguchi and Iwamatsu (2018) for different material and color interventions

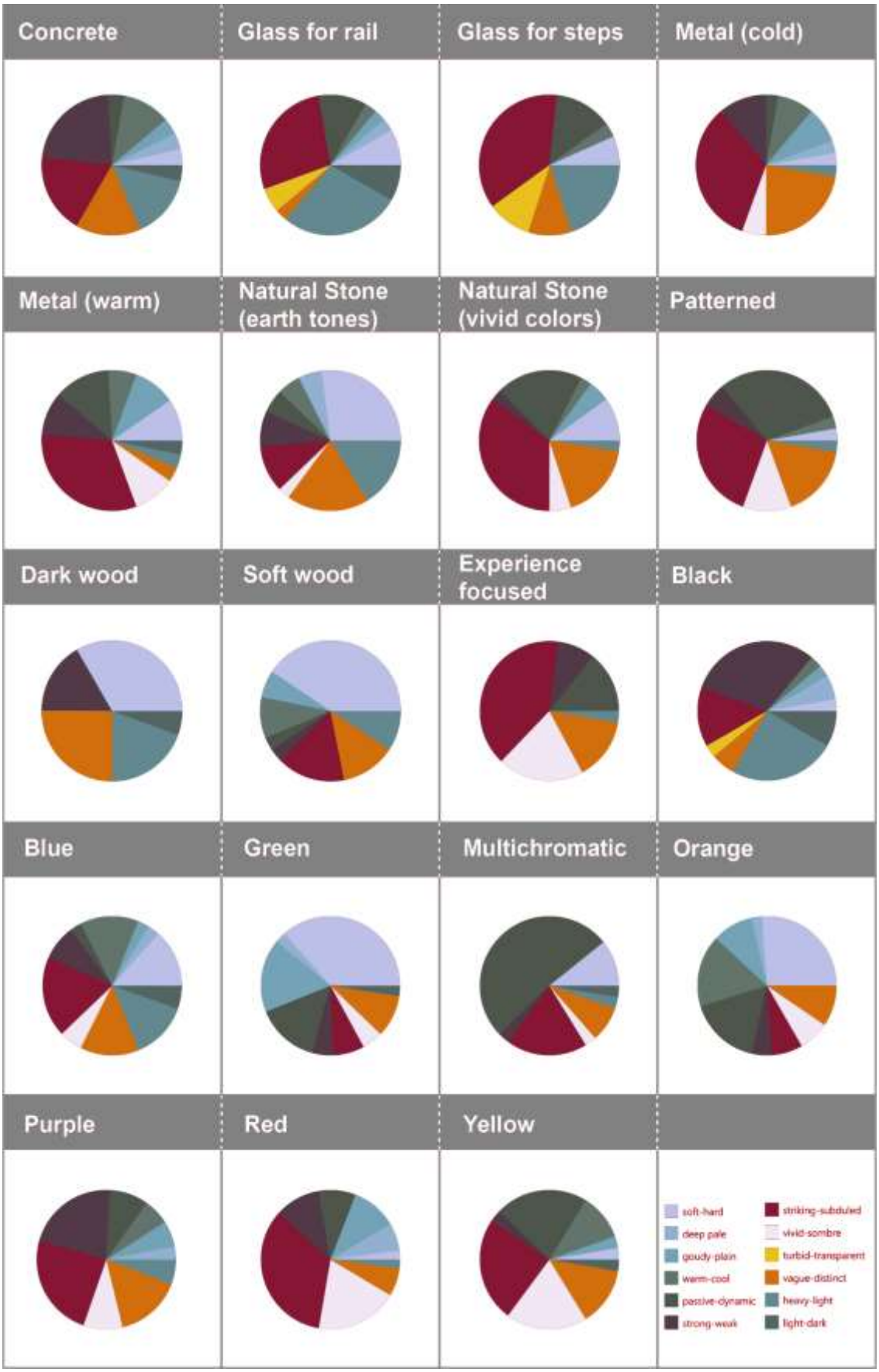

Figure 3. Frequency levels of the codes generated from the study of Gao et al. (2007) for different material and color interventions

Facade Color Design

In this study, the proposed facade color design exercise was planned to improve students' knowledge about different types of chromatic combinations, and social and environmental values that facade designs imply. The works of students show that the proposed facade color exercises were successful in the comprehension of monochromatic, achromatic and multichromatic approaches to color composition. However, in terms of developing facade designs that reflect social and environmental characteristics, the proposed exercises did not reach the targeted level. When planning the task, it was thought that it would help the students to propose a color composition by paying attention to environmental and social values of the campus, but no trace of such an approach was found in the student works (Figure 4).

Figure 4. Some of the student works from facade color design assignment

To sum up, the group covered well the differences between monochromatic, achromatic and multichromatic facade color applications, but they treated the task by focusing only on the building itself and color change. They were not concerned about the social and environmental characteristics that the buildings attached to.

Benefiting Outer Sources in Creating Color Combinations to Manage Color and Space Relation

To develop the sense of color harmony, a series of exercises were planned within the scope of this research. In the first phase of the exercises, in the creation of the color scheme phase, benefiting from outer sources were encouraged. At first, each student worked with a pre-determined artwork and analyzed the colors of that artwork by pixelating it. Then, each student decided their color scheme by benefiting from the previous artwork analysis. Students applied their color scheme by manipulating the photo of İzmir Silos of Turkish Grain Board. The building complex was built in 1958, located in the city's developing railway network, port hinterland and other industrial areas and became a symbol of the city's agricultural wealth and history (Karadağ & İncedere, 2020). Now, its location has turned into a central urban point of İzmir metropole, and in addition to its agricultural industry root, it also carries the marks of change in urban culture. So, students were expected to consider all these aspects while creating

the new compositions. At the first stage, students delivered their initial searches for the impacts of different surface qualities while using the same color scheme (Figure 5), and then the researcher gathered them in a new document and transmitted the initial ideas of their peers.

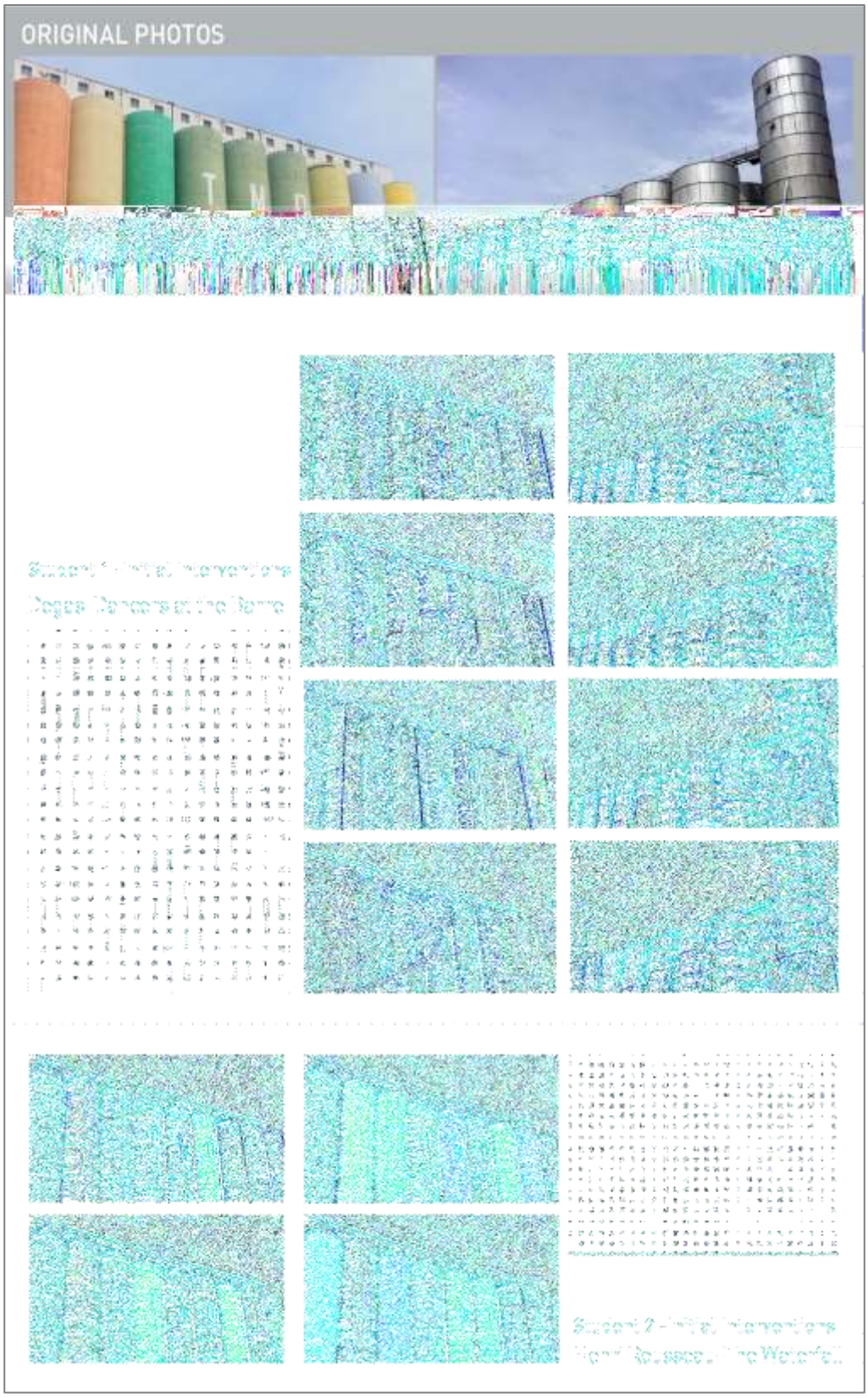

Figure 5. Examples of students' initial color scheme applications for İzmir Silos of Turkish Grain Board

For the final submission of this assignment students revised their initial ideas and critiqued their final outputs in terms of architectural context. They evaluated the final proposal in terms of design elements, social and environmental context. Most of the students managed to change the effects of different design elements, changed the dynamism and tried to achieve a new rhythm, a new order and harmony just by changing the color, as in Figure 6. On the other hand, the investigation of the social and environmental context was more in the background compared to the focus on design elements.

Figure 6. An example of finals submission for İzmir Silos of Turkish Grain Board assignment and original photos of the buildings used in the assignment

CONCLUSION

Being aware of the significance of practicing color in architecture in a correct way, this study delved into the effectiveness of color studies in distance architectural education during the COVID-19 pandemic, specifically focusing on the comprehension of color theory, the experience of color and material combinations in relation to emotions, the guidance of interior space experiences through color and material changes, and the exploration of the potential of color in architectural compositions. The findings revealed the pros and cons of the applied methods on delivering the targeted topics. Students did well in comprehension of basics of color theory.

Color, part of the sophisticated vision procedure, is a distinguishing factor of physical surfaces (Smart, 1997; Kuehni, 2012). In other words, our typical sensation of color is highly dependent on the material world. In this study, discriminating behaviors of colors were experienced through materials having different surface qualities by students. Findings showcased that tactile experience in the same physical setting is valuable in terms of understanding material effect. Face-to-face interaction seems to be advantageous for comprehending the people's emotional reactions to the color and material combinations. With the support of the first five weeks' physical experimentation with material and color, students showed notable improvement in achieving target emotions through their design regarding Robinson's (2008) emotion segmentation related with objects properties.

As Rasmussen (1964) highlighted creating spatial experiences and providing adequate function with a tailored composition of design elements is the key aspects of architecture discipline. While experiencing a space, people attribute values to these spaces, create meanings through interaction with that space. Interaction level increases with interiority since the scale is more compatible with the human dimension and human senses in interior spaces. Thus, in terms of architecture, interior space experience of people needs to be carefully planned with the application of design elements. In that sense, students explored this through the color changes in the spiral stairs. Thus, as Manav (2017) described, they could reflect their experience, memories, culture and perception through new color interventions. Furthermore, they found a chance to evaluate their color choices' effects on other people's perception of an interior element, and they were able to track similarities in the others' perception to the new color design proposals. When the shared thoughts on the new proposals analyzed through the "Word Image Scale" from the study of Horiguchi and Iwamatsu (2018) and "Color Emotional Word Pairs" Gao et al. (2007), it has been revealed that even though there weren't any kind of interaction between students in asynchronous education, it had been possible to create similar the interior space experiences only by a digital visual. On the other hand, findings about this exercise showed that dynamic form of the stairs had affected students' evaluation in some cases. So, it is obvious that in architecture and design education, even though via asynchronous online methods, it would be possible to transmit the potential of color change on guiding the individuals' interior space experience.

Although, all the planned actions were carried out to improve the students' color practice skills in terms of architecture, some of the course works were specifically designed to contribute to comprehending colors' dominancy and power on certain aspects of an architectural design. In that sense, at first color design of facades examined through various exercises. This exercise included familiar places for students or their own projects to provide enough data for them to evaluate their color proposals comprehensively with its physical, social and environmental aspects. However, results showed that although most of them was successful in comparing how color affected the perception of other design elements and architectural design, in general they did not set solid links between the buildings' environmental and social context. In other words, they approached the process in a singularity way, they did not consider the whole. Facades' importance on creating visual character of an urban area and buildings' time and value reflective properties were not explored much through these actions (Serra and Codoner,2014; Ferring; 2014; Lee et al., 2020). On the other hand, benefiting from outer resources and mimicking color schemas of valuable artworks helped them to explore the effects of harmonic color schemas in improving aesthetic quality of architectural designs and increasing users' place attachment level.

In summary, while online education demonstrated effectiveness in certain aspects of architectural color education, face-to-face interactions remained crucial for a comprehensive understanding of the emotional and tactile dimensions of color and material combinations. Similar to the other studies in distance architectural education, the study underscores the importance of integrating various modes of communication to fully cover the multifaceted nature of color in architectural education. As in the professional practice in architecture and design, architecture and design education need to carry harmonic amendments with its time and place.

REFERENCES

Adedoyin, O. B., & Soykan, E. (2023). COVID-19 pandemic and online learning: the challenges and opportunities. *Interactive Learning Environments , 31*(2), 863-875. https://doi.org/10.1080/10494820.2020.1813180

Agoston, G. A. (2013). *Color Theory and Its Application in Art and Design (Vol. 19).* Springer.

Akçay Kavakoğlu, A. G., Domingo-Callabuig, D., & Bilen, Ö. (2022). Architectural design communication (ADC) in online education during COVID-19 pandemic: A comparison of Turkish and Spanish universities . Open House International 47(2): 361-384. *Open House International, 47*(2), 361-384. https://doi.org/10.1108/OHI-07-2021-0144

Alburgawi, S. A., & Al-Gamdi, M. A. (2022). Impact of COVID-19 pandemic on architecture design studio pedagogy in Saudi Arabia. *Open House International, 47*(4), 594-604. https://doi.org/10.1108/OHI-12-2020-0178

Alfiras, M., Bojiah, J., & Yassin, A. A. (2020). COVID-19 pandemic and the changing paradigms of higher education: A Gulf university perspective. *Asian EFL Journal, 27*(5), 339-347.

Allu-Kangkum, E. L. (tarih yok). COVID-19 and sustainable architectural education: challenges and perceptions on online learning. *IJRDO-journal of Educational Research , 6*(2), 7-12.

Amro, D. K. (2022). The Impact of COVID-19 Lockdown on Design Students' Performance Case Study in the UAE . *International Journal of Art & Design Education , 41*(1), 108-124. https://doi.org/10.1111/jade.12378

Asensio, P., & Kliczkowski, H. (2002). Legorreta+ Legorreta. A Asppan,SL.

Boake, T. M. (2013). *Understanding Steel Design: An Architectural Design Manual.* Walter de Gruyter.

Brzezicki, M. (2020). Strengths and weaknesses of architectural education on-line classes conducted during COVID-19. *World Transactions on Engineering and Technology Education, 18*(4), 381-386.

Carlos, J., & Cesar, D. (2018). Reflections and experiences on the teaching of colour in the architecture and urbanism course in the University of São Paulo. *Journal of the International Colour Association*(22), 15-22.

Cesar, J. C. (2018). Chromatic harmony in architecture and the Munsell color system. *Color Research and Application, 43*(6), 865-871. https://doi.org/10.1002/col.22283

Ceylan, S., Şahin, P., Seçmen, S., Somer, M. E., & Süher, K. H. (2021). An evaluation of online architectural design studios during COVID-19 outbreak. *Archnet-IJAR: International Journal of Architectural Research , 15*(1), 203-218. https://doi.org/10.1108/ARCH-10-2020-0230

Csillag, P., Lucia, A., & Hirschler, R. (2018). Overview of colour education in Brazilian Universities: a focus on design courses in the state of São Paulo. *Journal of the International Colour Association*(22), 4-14.

Daniel, S. J. (2020). Education and the COVID-19 pandemic. *Prospects , 49*(1), 91-96. https://doi.org/10.1007/s11125-020-09464-3

Efron, S. E., & Ravid, R. (2019). *Action Research in Education: A Practical Guide.* Guilford Publications.

Ekman, P. (1973). Universal facial expressions in emotion. . *Studia Psychologica, 15*(2), 140-147.

Elliot, J. (1991). *Action Research for Educational Change.* McGraw-Hill Education (UK).

Erkök , F., Eren, Ç., Uz Sönmez , F., & Aydınlı, S. (2006). A paradigm shift in the first year design education. *ITU A/Z , 2*(1), 62-78. https://doi.org/https://www.az.itu.edu.tr/

Fallatah, S. A.-1.-2. (2020). Senior interior design students' perceptions about distance learning in the shadow of COVID-19. *Journal Of Public Health Research , 9*(1), 29-37. https://doi.org/10.4081/jphr.2020.1914

Ferring , M. (2014). Color and architecture in 1970s Sweden. *Color Research and Application , 39*(5), 492-498. https://doi.org/10.1002/col.21839

Fewella, L. N. (2023). Impact of COVID-19 on distance learning practical design courses. *International Journal of Technology and Design Education, 33*, 1703-1726. https://doi.org/10.1007/s10798-023-09806-0

Gao, X. P., Xin, J. H., Sato, T., Hansuebsai, A., Scalzo, M., Kajiwara, K., . . . Billger, M. (2007). Analysis of cross-cultural color emotion. *Color Research & Application , 32*(3), 223-229.

https://doi.org/10.1002/col.20321

Gill, A. S., Irwin, D. S., Ng, R. Y., Towey, D., Wang, T., & Zhang, Y. (2020). The future of teaching post-COVID-19: Microlearning in product design education. *2020 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (* (s. 780-785). IEEE. Doi: 10.1109/TALE48869.2020.9368322

Given, L. M. (2008). *The Sage Encyclopedia of Qualitative Research Methods.* Sage publications.

Glasner, B., & Schmidt, P. (. (2010). *Chroma: Design, Architecture and Art in Color*. DE GRUYTER.

Glasser, D. (2000). Reflections on architectural education. *Journal of Architectural Education, 53*(4), 250-252. https://doi.org/10.1162/104648800564662

Gou, A., & Wang, J. (2017). A comparison between wishes and status: Gray is not the preference for residents while the city shows neutral colors. *Color Research and Application, 42*(5), 650-663.

Grover, R., & Wright, A. (2023). Shutting the studio: the impact of the Covid-19 pandemic on architectural education in the United Kingdom . *International Journal of Technology and Design Education, 33*(3), 1173-1197. https://doi.org/10.1007/s10798-022-09765-y

Gunawardena, C. N., & McIsaac, M. S. (2013). Distance education. *Handbook of Research on Educational Communications and Technology* (s. 361-401). içinde Routledge.

Hassanpour, B. (2023). Transformational contribution of technology to studio culture: experience of an online first-year architecture design studio during the COVID-19 pandemic . *Archnet-IJAR: International Journal of Architectural Research , 17*(2), 393-408. https://doi.org/10.1108/ARCH-12-2021-0328

Horiguchi, S., & Iwamatsu, K. (2018). From Munsell color system to a new color psychology system. *Color Research & Application, 43*(6), 827-839. https://doi.org/10.1002/col.22286

Iranmanesh, A., & Onur, Z. (2021). Mandatory virtual design studio for all: Exploring the transformations of architectural education amidst the global pandemic . *International Journal of Art & Design Education, 40*(1), 251-267. https://doi.org/10.1111/jade.12350

Itten, J. (1970). *The Elements Of Color. (Van Hagen E, translator; F. Birren, editor).* John Wiley & Sons.

Janssens, J., & Mikellides, B. (1998). Color Research in Architectural Education — A Cross-Cultural Explorative Study. *Color Research and Application, 23*(5), 328-334. https://doi.org/10.1002/(SICI)1520-6378(199810)23:5%3C328::AID-COL9%3E3.0.CO;2-Y

Jover, L. N., & Alba, C. L. (2002). Perception and Phenomenology of Light and Colour in the Architecture of Luis Barragán. M. A. Ródenas-López, j. Calvo-López, & M. Salcedo-Galera (Dü.), *Architectural Graphics. EGA 2022.Springer Series in Design and Innovation.* içinde *23*, s. 333-341. Cham: Springer.

Karadağ, A., & İncedere, L. (2020). Kentsel belleğin sürdürülebilirliği açısından İzmir'deki endüstri miras alanlarının önemi: Alsancak liman ardi bölgesi örneği. *Ege Coğrafya Dergisi, 29*(1), 57-71.

Kaya, N., & Crosby, M. (2006). Color associations with different building types: An experimental study on American college students. *Color Research and Application, 31*(1), 67-71. https://doi.org/10.1002/col.20174

Kobayashi, S. (1981). The aim and method of the color image scale. *Color Research & Application , 6*(2), 93-107. https://doi.org/10.1002/col.5080060210

Kowaltowski, D. C., Gomes da Silva, V., de O Neves, L., Deliberador, M. S., Zara, O. O., Colleto, G. M., & Victorio, E. R. (2020). Action research and architectural sustainable design education: A case study in Brazil. *International Journal Of Technology and Design Education, 30*, 815-836. https://doi.org/10.1007/s10798-019-09525-5

Kuehni, R. G. (2012). *Color: An Introduction To Practice And Principles.* John Wiley & Sons.

Lee, K., Yang, Y., & Zheng, Z. (2020). Research on color harmony of building façades. *Color Research and Application, 45*(1), 105-119. https://doi.org/10.1002/col.22448

Lotfabadi, P., & Mousavi, S. A. (2022). Adaptation of architectural education pedagogy in addressing COVID-19 pandemic . *Journal of Educational Technology and Online Learning, 5*(4), 1094-1105. https://doi.org/10.31681/jetol.1150608

Manav, B. (2017). Color-emotion associations, designing color schemes for urban environment-architectural settings. *Color Research and Application, 42*(5), 631-640. https://doi.org/10.1002/col.22123

Manav, B. (2007). Color-emotion associations and color preferences: A case study for residences. *Color Research and Application , 32*(2), 144-150. https://doi.org/10.1002/col.20294

Martosenjoyo, T. (2021). Architecture education during the covid-19 pandemic. *Education Quarterly Reviews, 4*(4), preprint.

Meerwein, G., Rodeck, B., & Mahnke, F. (2007). *Color-communication in architectural space.* De Gruyter.

Megahed, N., & Hassan, A. (2022). A blended learning strategy: reimagining the post-Covid-19 architectural education. *Archnet-IJAR: International Journal of Architectural Research, 16*(1), 184-202. https://doi.org/10.1108/ARCH-04-2021-0081

Nigam, S., & Kapoor, V. (2021). Perspective of interior design students towards online classes amid COVID-19 pandemic in India. *The Online Journal of Distance Education and e-Learning, 9*(2), 275-284.

Norton, L. (2018). *Action research in teaching and learning: A practical guide to conducting pedagogical research in universities.* Routledge.

Plutchik, R. (2001). The nature of emotions: Human emotions have deep evolutionary roots, a fact that may explain their complexity and provide tools for clinical practice . *American Scientist, 89*(4), 344-350.

Rasmussen, S. E. (1964). *Experiencing architecture.* MIT Press.

Robinson, D. L. (2008). Brain function, emotional experience and personality. *Netherlands Journal of Psychology , 64*, 152-168. https://doi.org/10.1007/BF03076418

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions* . Jossey-Bass.

Serra, J. (2013a). Three color strategies in architectural composition. *Color Research and Application, 38*(4), 238-250. https://doi.org/10.1002/col.21717

Serra, J. (2013b). The versatility of color in contemporary architecture. *Color Research and Application, 38*(4), 344-355. https://doi.org/10.1002/col.21734

Serra, J., & Codoner, A. (2014). Color composition in postmodern western architecture. *Color Research and Application, 39*(4), 399-412. https://doi.org/10.1002/col.21814

Smart, J. C. (1997). On some criticisms of a physicalist theory of colors. A. Byrne, & D. R. Hilbert içinde, *Readings on Color: The philosophy of color (Vol. 1).* MIT Press.

Stringer, E. T. (2008). *Action research in education.* Upper Saddle River, NJ: Pearson Prentice Hall.

Unver, R. (2002). Color education in architecture. *9th Congress of the International Colour Association. 4421*, s. 1000-1003. Rochester, NY: SPIE. https://doi.org/10.1117/12.464645

Ural, S., Akbay, S., & Altay, B. (2002). Progression of color decision making in introductory design education . *Color Research and Application , 42*(6), 849-860. https://doi.org/10.1002/col.22129

Yuan, J., Xie, Y., & Brooks, K. (2022). Explore industrial design pedagogy under the pandemic in the US. *in Lockton, D., Lenzi, S., Hekkert, P., Oak, A., Sádaba, J., Lloyd, P. (eds.) DRS2022:Research Papers* (s. 1-13). Bilbao, Spain: DRS. https://doi.org/10.21606/drs.2022.456