INFLUENCE OF COLOR IN DESIGN THINKING PROCESS: A CASE OF BASIC DESIGN EDUCATION

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BY

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ABSTRACT

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Design education aims to enable the student to learn the design culture, use the appropriate design language while solving design problems, and develop creative thinking skills and create original products. Color also has an essential place in design education and effectively discourse among design elements. The correct and effective use of colors is essential for the correct expression of the design. It contributes to the development of the students' creative thinking ability and help them produce original works. In this sense, this study was mainly carried out with basic design students in Çankaya University, Department of Interior Architecture, with a survey study investigating the 'effect of color in the design thinking process'. Research results show that the effect of color in the design process is significant. In addition, the research results show that the effect of color contributes positively to the creative thinking process and problem-solving process.

Keywords; *Color, Basic Design, Design Thinking Process, Creativity, Creative Thinking Process.*

ÖZ

TASARIM DÜŞÜNME SÜRECİNDE RENK ETKİSİ: TEMEL TASARIM DERSİNDE ÖRNEK BİR ÇALIŞMA

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Tasarım eğitimi, öğrencinin tasarım kültürünü öğrenmesini ve tasarım sorunlarını çözerken uygun tasarım dilini kullanabilmesini, yaratıcı düşünme yeteneğinin gelişerek özgün ürünler yaratmasını amaçlamaktadır. Rengin de tasarım eğitiminde önemli bir yere sahip olduğu ve tasarım öğeleri içerisinde etkin bir söylevi bulunduğu düşünülmektedir. Renkleri doğru ve etkili kullanmanın, tasarımın doğru ifade edilebilmesi için önemli olduğu ve öğrencinin yaratıcı düşünme yeteneğinin gelişime katkı sağlayarak özgün çalışmalar ortaya çıkartmasına yardımcı olacağı düşünülmektedir. Bu anlamda, bu çalışma esas olarak Çankaya Üniversitesi, İç Mimarlık bölümünde, temel tasarım öğrencilerinin katılımı ile 'tasarım düşünme sürecinde rengin etkisinin' araştırıldığı anket çalışması ile gerçekleştirilmiştir. Araştırma sonuçları tasarım sürecinde rengin etkisinin olumlu yönde olduğunu göstermektedir. Ayrıca araştırma sonuçları, yaratıcı düşünme sürecine ve problem çözme sürecine de rengin etkisinin olumlu yönde katkı sağladığını göstermektedir.

Anahtar Kelimeler: *Renk, Temel Tasarım, Tasarım Düşünme Süreci, Yaratıcılık, Yaratıcı Düşünme Süreci.*

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1. INTRODUCTION

A design studio is considered the heart of design education. It is a sequential working process that usually lasts for eight semesters (four years) in interior architecture education. In the first stage, there is studio education, called basic design and is generally given in two semesters depending on the curriculum. Although the first step of this studio training differs from the curriculum, it is given within a semester or two.

Basic design education is the first step for educating design students (Akbay, 2003). In addition, it is the first place where students encounter the 'Design'. For this reason, the basic design course is of great importance in the departments that provide design-based education (Ustaomeroglua et al., 2015). The aim of this course—which has been given in design schools since the Bauhaus schools in 1919—is to develop students' design skills, to improve their decision-making skills, to generate problem-solving skills, and to teach general design rules (Ustaomeroglua et al, 2015, Birlik, 2012, Öztürk, Beşgen, & Kuloğlu, 2018). The design process results from creative thinking that is established by the interrelation of seeing, dreaming, and drawing (Yakın, 2012). In design education, design elements and principles are accepted and taught as the basis of the course (Ustaomeroglua et al., 2015). Considering the theoretical background, the basic design elements are point, line, shape, form, movement, direction, size, space, texture, color, light, and shadow. Basic design principles are accepted as contrast, harmony, balance, symmetry, repetition, emphasis, dominance, and hierarchy (Güler, 2012). Students use these principles and elements in design courses to achieve the design process from abstract to concrete through 2-dimensional and 3-dimensional works. This process is known as the creative thinking process. Accordingly, color is thought to be a powerful visual tool for the designer (Sherin, 2012).

In design-related departments, related topics to color science are given equal importance since color has attracted the attention of designers and artists for ages (Agoston, 1979). Thus, color is accepted as a science that has practical aspects for artists and designers (Agoston, 1979). Additionally, color is believed to be a contributor to the creative thinking process of design.

1.1 AIM OF THE THESIS

This study aims to examine the relationship between color and the design thinking process and investigates whether color contributes to the creative thinking process.

The research questions of the study are:

What is the effect of color on the design process in basic design course?

What is the effect of color on the creative thinking process?

What is the effect of using color in the design process?

Since basic design education is the basic course in interior architecture schools, it is decided to conduct the study with basic design studio's students. The students in Çankaya University, Department of Interior Architecture, participated in conducting this study.

1.2. STRUCTURE OF THE THESIS

The thesis consists of five chapters. The first chapter, which is the introduction, briefly explains the purpose and scope of the study. Then comes the second chapter of the study. This chapter examines basic design education, basic design concepts, visual thinking process, creative thinking process, and decision-making and problem-solving process. Then, color was considered a design element, and the place and importance of color in design education was investigated. In the third chapter, the original thesis structure is introduced. The methodology, subjects, and procedure of the study are explained in detail. The fourth chapter presents a detailed analysis of the data obtained from students' responses to the survey designed to conduct the study. The last chapter, the conclusion, evaluates and discusses the results obtained from the study.

CHAPTER I

2. DESIGN THINKING PROCESS AND BASIC DESIGN EDUCATION

The word ‘basic’ denotes the object or principle of which anything is built: The basis of anything. “*If the foundation of a structure is mentioned; If we talk about an object, the basis of education; Basically, a principle is mentioned*” (Hançerlioğlu, 1970, p. 258). “*Design, on the other hand, means the reproduced image of the perceived, the view created for the first time in the mind, the reproduction of what has already been created*” (Hançerlioğlu, 1970, p.251). Thus, design is a context tool between perception and concept. It employs human imagination, the main driver of learning and taking actions, especially artistically (Hançerlioğlu, 1970). Various definitions of design depend on context. However, the most accepted definition is that design is a systematic data-supported process represented by models, based on theory, and focused on problem-solving (Tracey and Boling, 2013; cited in Hokanson, 2014). The concept of basic design originated in Bauhaus, a design school in Germany founded in 1919. By then, it aimed to bring students’ readiness to some point by helping them recognize their characteristics, control their judgments, and discard their prejudices (Seylan, 2005; cited in Bingöl, n.d.).

Basic design education is a process that activates students' intellectual stages such as perception, impression, observation, research, association, invention, knowledge, and evaluation. Subsequently, it transforms these stages into some original forms (Aşkın, 2018). It aims to enable students to observe the environment sensitively, distinguish and judge various elements around them, improve their abilities to make aesthetic choices, and increase their visual expression capabilities (Erim, 2011). Thus, it deals with design elements, principles, geometric forms in 2-dimensional and 3-dimensional compositions, and organization and relationships (Obeid, 2019). Students are to be prepared for upper grades with basic design elements by bringing the visual elements into use. Basic design

course is considered a preparatory stage in which art is educated. Thus, knowledge, experience, and skills emerge in students that will contribute to students' studies in upper classes.

In basic design education, the process starts with giving theoretical knowledge to the students. At the same time, students are provided to practice this knowledge to solve a design problem. The resulted works are publicly criticized as a subject of discussion in the studio environment. To ensure that students are participating in the criticism, and that they fully understand the design problem, their designs are corrected by answering the questions posed to them from time to time (Yıldırım, 2018). Given that the education given in basic design is productive for students, it suggests that designers will increase their works' quality during their professional life in the future.

Itten states that basic design objectives to three: 1) to reveal the creative thinking abilities of students with their own experiences and perceptions through design lessons and practices; 2) to provide students with appropriate career plans through experiments; and 3) to teach various types of materials, basics of form, design principles, and color (Cindioğlu, 2019). The previous basic design research shows that creativity and visual perception are based on one's previous experiences. For instance, Düzenli, Alpak, and Özkan's (2017) study with 1st-year basic design students had a survey with a 7-point Likert scale to investigate the effects on learning creativity in the course. The results showed that the course helped design students develop their own unique identities.

Measuring the creativity and aesthetic sensitivity in basic design courses, Erim (2011) also conducted a study with 1st-year students of the Painting-Business department, Uludağ University. Initially, the students made a design with the theme of 'Hat' and prepared for an exhibition. After the exhibition, they participated in the survey, which was prepared using a 3-point Likert scale. The students were asked questions about the process they went through in the basic design course. It was concluded that 'with this study in the basic design course, the aesthetic sensitivities and creativity of the students improved'. In the survey study, in which 70 students participated, 68 students answered the proposition, "I believe that the exhibition of the Basic Design course is beneficial in developing our creativity". 93% of the students marked yes, 4% no, 3% no idea. The fact that most of the

students chose the 'yes' option in this survey shows that this work in the basic design course improved the aesthetic sensitivity and creativity of the students.

Another study about movement and direction was conducted. It revealed that questioning and researching improved students' knowledge level, perception, aesthetic, and critical perspectives. Furthermore, it improved their creativity and self-confidence when students (1st-year, Faculty of Education, Uludağ University) were asked to research human figure in sports branches given to them. They also were asked to study sections representing the movement in an illustrative way with pencil drawing, gouache paint, and collage techniques (Erim, n.d.).

An empirical study on the Benefits of Visual Analogy in Basic Design Education by Çubukçu and Dündar's (2007) is conducted to examine whether visual images used in the basic design course improve students' creativity. The study was carried out with the participation of the 1st-year students of Dokuz Eylul University, Department of City and Regional Planning. Students were divided into groups and asked to design eight compositions that conveyed 'harmony, contrast, emphasis, cluster, unity, diversity, radial balance, and asymmetrical balance'. Visual cues were shown to half of the student groups only. It was concluded that students who were shown visual cues achieved more creative work. Thus, the visual analogy has a positive effect on creativity.

Tekel, Tamer, Memlük, Gürer, and Kızıltaş (2016) conducted a study that aimed to question the relationship between visual perception skills and development level of students in basic design education, and their interest and past experiences in visual arts. The study was conducted with 1st-year students of the Department of City and Regional Planning, Gazi University. The study revealed that students who have interest and experience in visual arts before basic design education have more positive visual perception and expression development processes than students who have no interest and experience in visual arts, and that visual perception can be improved with basic design education.

According to the previously mentioned studies, it can be suggested that a basic design course develops creativity. Additionally, visual analogy also contributes to this creativity. The processing of visual elements in the basic design course helps students create more creative and original works. In addition, the education received in the basic

design course improve the students' creativity, contribute to the studio education and professional life of the students in the upper classes, and help them produce original designs/projects.

This study is similar to previous studies researching the influence of visual elements on creative and design thinking. However, it ties to understanding the contribution of color, as one of the visual elements, to creative thinking and design thinking process.

2.1 DESIGN THINKING PROCESS

"Design thinking is something inherent within human cognition; it is a key part of what makes us human." (Cross; cited in Cindioğlu, 2019, p. 29).

Design is both the product that would emerge and the whole process consisting of various stages to reveal the product. With the education that is given in the Basic Design course, students learn the process and progress of the work. Students go through the process until they reach the product in the design studio is called the 'design thinking process' (Demirbaş & Demirkan, 2003). The role of the design studio can be considered in three steps: (a) learning and practising some new skills such as visualization and representation; (b) learning and practising a new language; (c) thinking architecturally. The educational experience in the design studio covers these three phases simultaneously (Demirbas & Demirkan, 2003).

The design thinking process can be a conscious or subconscious effort that designers use in almost every project. The design thinking process plays a crucial role in developing innovative design solutions for many designers (Abowardah, 2018). Design courses contribute to students' skills in understanding, defining, and analyzing. Therefore, basic design courses are essential for the students to be prepared for the stages they will go through mentally and learn this cognitive context of the process. With the inquiry-discovery approach in design thinking, students' problem-solving or creative abilities and performances can be increased (Treffinger, 1980; cited in Girgin, 2019).

Design thinking creates an opportunity for the designer to gain specific skills and knowledge (Bootleg, 2011; cited in Girgin, 2019). To be a design thinker, solving complex problems is making informed decisions (Löwgren & Stolterman, 2004; cited in Girgin,

2019). In the context of education, design thinking skills can be learned through pedagogical approaches. Activities that include problem-based learning, project-based learning, and inquiry-based learning can be carried in the classroom. In curricula based on design thinking, students are expected to acquire specific skills, including collaboration, problem-solving, and empathy (Girgin, 2019). According to Borwn (2008), design thinking emphasizes drawing thinking. Using design thinking, the designer's sensitivity and matching methods and the questions of people's needs, what methods can be applied technologically, and how the methods can be applied are sought. On the other hand, Martin (2009) focuses on creative thinking in design thinking through process-oriented, existing challenges, accepted explanations, ideas generated, and possible new solutions. Meniel and Leifer (2011), on the other hand, express design thinking as human-centered by examining and solving problems. According to Brown (2008), four basic categories were determined for design thinking (Girgin, 2019) which are: (a) it is human-oriented design, (b) It provides integrative thinking, (c) it includes design management process stages, and (d) it is used as a strategy in the teaching process.

The stages of the design thinking process have been widely recognized as seven stages: define, research, think, prototype, choose, apply, and learn. The first is to define the problem. At this stage, what is required for the design to be realized is determined. During the research phase, past information is reviewed. At the idea stage, ideas are generated, and needs are determined through brainstorming. During the prototyping phase, the first samples appear. Then, selections are made on the first samples, the existing models are developed, and the design is implemented (Ambrose & Harris, 2010). It can be said that the process starts abstractly and ends by obtaining a concrete result.

At its core, design thinking refers to how designers see and ultimately think. (Liu, 1996). It is an iterative and interactive process where designers see the occurrences in some representation of problem-solving concepts/ideas, establish relationships between ideas to solve the problem and view what is drawn as information (Razzouk and Shute, 2012). that the basis of this process is visual perception being a perception based on mental processes and experiences (Tekel et al., 2016). Arnheim (1974) draws attention to the fact that the most effective tool of the individual's cognition is the sense of sight. Practitioners argue that visual perception is a form of learning in itself (Tekel et al., 2016). In this

context, basic design education contributes to the development of visual perception (Tekel et al., 2016).

2.1.1. Visual Thinking Process

Vision starts with the eye, in which whatever is seen by an individual is transmitted to the brain. However, only desired practical visual details and events are transmitted to the brain. By priority, perceptual distinguishability becomes the control mechanism, and other visual information is set in the background process. Thus, receiving and reacting to the visual elements align with past experiences in the environment (Çelik, 2019). Özol (2012) "*Perception is when what is notified transmitted to the perception and that makes the creature a meaningful entity in line with its past experience*" (Çelik, 2019, p.8).

In design education, Goldschmidt and Smolkov (2006) suggest that the sources of inspiration that serve designers are verbal and visual sources (Çubukçu & Dündar, 2008). Designers in all disciplines, including architecture and planning, are expected to think visually and are more concerned with visual features than others (Bilda & Gero, 2004). Therefore, for design educators, the effect of visual cues in improving visual thinking ability emerges as a more critical question than verbal ones. Visual cues can help to learn how to develop ideas, as they give an idea of how soft information or concepts translate into concrete results or actual practice. Thus, it is assumed that visual cues will improve visual thinking ability and lead to better design solutions for design problems by using visual cues (Çubukcu & Dündar, 2008).

Design education, when considered the process of creating, experiencing, and researching, is a method that brings creativity to the forefront gains importance in this process. To contribute to the visual abilities of students, design principles are included in the basic design course. The principles adopted by the individual in the design process contribute to their creativity by improving their perceptions and experiences. Visual language needs to be developed to increase the expressive power of the individual. This visual language is necessary for the establishment of visual dialogue as well as for the occurrence of visual thought (Erim, 2011).

When 'Visual Perception' is mentioned in design education, one of the first things that come to mind is 'Gestalt Visual Perception Theory'. Gestalt Visual Perception Theory

is one of the leading theories in psychology, educational sciences, especially in art education, compatible with design elements and principles. The basic principle of Gestalt theory about art is that human perception naturally groups objects and creates a whole by experiencing them together. In other words, thinking of everything that consists of parts as a whole in mind is the basis of this theory. Wertheimer (1923/1938), one of the Gestalt theorists, argues that the principles of visual organization are intuitive within every human being. According to Wertheimer, the visual world is so complex that the human mind tries to perceive the environment in its simplest form to overcome this complexity. In the perception process, the individual perceives the composition formed by the objects. In Gestalt theory, it is examined what kind of principles are perceived as a whole (Tekel et al, 2016). These principles are figure and ground, proximity, similarity, connection, continuity, and simplicity. In design education, it is thought that the development of creative thinking skills is as crucial as visual perception since design is a complex thinking activity that requires creative solutions (Eke, 2019). The presence of visual stimulates is positively related to the emergence of creativity (Goldschmidt & Smolkov, 2006).

2.1.2. Creative Thinking Process

"*The Latin word 'creatus' is defined in the Current Dictionary of the Turkish Language Institution as 'the hypothetical disposition that is accepted to exist in every individual, which leads to the creation of something*" (Atakan, 2019, p. 12). "*It is an action that is described as a mental process and evaluated as the emergence of a new idea or product*" (Atakan, 2019, p. 12). The word "creation" is used in the following terms: to create, to create from nothing, to cause existence; produce, cause, create, bring forth; Exploring with a new sequence of operations; effectively portraying a character for the first time; The definition of the word 'creator' is as follows: having the power to create, belonging to creation, inventor, producer (Akgün, 2002; cited in Camcı, 2017).

The most crucial common view accepted by all thinkers, artists, and educators is that creativity exists, is innate, and can be developed in every individual (Erim, 2011). Creativity is observed during the day when the individual brainstorms about some issues without being aware of them. However, students can be taught how to develop their creative power by bringing it out to action in academic environments. The creative design

process improves students' perception, understanding, interpretation, and expression skills (Aşkın, 2018). Therefore, it can be said that creativity education is an important issue that should be discussed in academic environments, and the awareness of it should be raised. Being aware of the creative power within the individual will be beneficial for advancing the design process more accurately. In other words, creative thinking helps to expand the limits of imagination as much as possible while generating ideas for solving a problem. Furthermore, it can be said that it is a mind-opening action that improves the designer's ways of thinking and is used to find new solutions (Koçkan, 2012).

Scientists have developed different models by dividing the creative thinking processes into stages. One of them is the Creativity Model, which consists of four steps proposed by Wallas in 1926, which is accepted as the basis of the creative process shown in Figure 1.

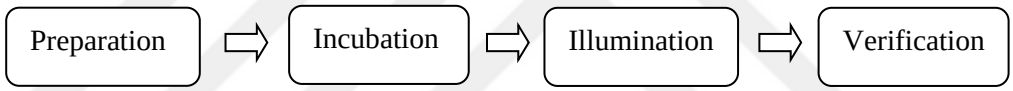

Figure 1: ‘‘Creativity Model (Adapted from Wallas 1926)’’

(Atakan, 2019, p. 18)

This model defines preparation as the first phase and consists of identifying as many factors as possible related to the problem that is sought to be solved. Another essential step in this phase is to redefine the problem. Redefining the problem requires stepping back away from it, going around it, looking inside the problem by defining it from a different perspective (Rawlinson, 1995; cited in Camcı, 2017). As for Incubation, it is the second phase of the thinking process. This is when the problem lies in the depths of our minds, without consciously considering it (Rawlinson, 1995; cited in Camcı, 2017). Later comes Illumination, which is the birth of thought when the thought to be used in solving the problem suddenly manifests itself. This process is also called enlightenment (Rawlinson, 1995; cited in Camcı, 2017). The final phase is Verification. In this process, all the ideas put forward are analyzed and evaluated to reach possible results. This process can be challenging for participants if the idea generation process is spent with many open-ended ideas (Rawlinson, 1995; cited in Camcı, 2017).

Another model is shown in Figure 2. It is the 4P model developed by Mel Rhodes (1961). "*According to this model, creativity is detailed not only in cognitive actions, but also in the positive effects of environmental factors on creativity, the creative characteristics of the person, the criteria for the product to be creative, and whether the process is creative or not*" (Atakan, 2019, p.18). The main theme of the model is not to limit creativity only to one's actions (Atakan, 2019).

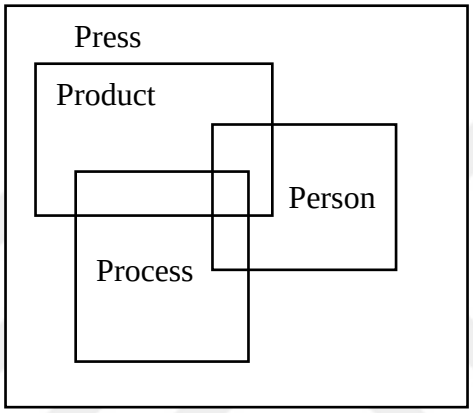

Figure 2: ''Model 4P (Adapted from Rhodes 1961)"
(Atakan, 2019, p. 19)

These four tools enable defining the concept of creativity and seeing the relationships between different kinds of effective criteria. Various criteria, including motivational conditions, personality factors, environmental conditions, factors and products, are effective on creativity (Hasırcı, 2000). While preparing the creative activity, techniques, methods, environment, and changes in the environment are considered essential factors for developing creativity. In this model, the Creativity Person is acknowledging specific behavioral characteristics of the creative individual. These characteristics should be studied to encourage creativity (Hasırcı, 2000). Early research on creativity has shown that a creative person will have features such as fluent thinking, remembering certain information indirectly or in unusual ways, thinking flexibly, being able to change without depending on habits, detailing what he knows with many additions, and having unusual abilities (Hasırcı, 2000). The works of creative individuals are often

unorthodox. They will have a language that they use uniquely, and they can produce many different solutions for their designs and works.

The Creative Process includes many operations performed by knowledge and mind. This process is a tool for using the knowledge that the individual already has. (Ward & others, 1995; cited in Hasırcı, 2000). The creative process may consider evaluating factors such as feeling that a problem exists, identifying the problem specifically, asking questions about the problem, clarifying the goal, deciding whether more information is needed to solve the problem, redefining familiar objects for new uses, and finding the best or more solutions among (Hasırcı, 2000).

As for Creative Product, this is where creativity is most objectively observed in production (Hasırcı, 2000). It can be said that it is the state of exhibiting the creativity of the individual. This step also gives information about how the process went. For a product to be called creative, it must have the following characteristics (Besemer & O'Quin, 1993 341-342): The product is surprising and original; it should be a useful product even if only for the person who created it; it should be unusual, different; and the problem given at the beginning is defined (Hasırcı, 2000). This resulting product can be regarded as the externalization of images (Demirkan & Afacan, 2012).

Finally, the atmosphere of the environment has a significant influence on the creative individual. Factors such as the design and organization of the learning environment, teaching techniques, and the atmosphere's quality affect an individual's creativity. Therefore, the idea for the environment of the creative individual should be aimed at developing the creative impulse. This is known as the Creative Press.

Creativity is a necessity for all areas of life. The design process is considered a problem-solving process that involves generating innovative solutions. In the design process, the designer creates a new product by combining their talent and imagination (Çubukçu & Dündar, 2008). The designer contributes to the creative process through interpretation. The design problem is the designer's own style that uniquely defines the design solution (Dietrich, n.d.). the design elements and principles used in the design methodology are tools that help designers express themselves. Of these tools, color is an element of design that offers many features (Dietrich, n.d.).

2.1.3. Decision Making and Problem-Solving Process

"*The problem is the obstacle against the forces that people gather to reach their goal*" (Baysal, 2003, p.4; cited in Çimşir & Baysal, 2019, p. 339). "*Problem-solving involves using knowledge and skills to come up with an acceptable solution*" (Evans & Brueckner, 1990, p.67; cited in Çimşir & Baysal, 2019, p.339). Problem-solving skills can also be defined as overcoming a problem or avoiding looking at the situation from one side, analyzing, meeting a need, offering a satisfactory and analytical response to a problematic situation, suggesting an opportunity, or showing an interest (Çubukçu, 2012, p.313; cited in Çimşir & Baysal, 2019). It is the process of choosing the appropriate alternative in the light of some criteria to realize a goal/objective. The decision-making process, which includes a series of mental actions, refers to the course of action and the path followed by the techniques and methods used to make decisions (Palabıyık and Çolakoğlu, 2012).

It is suggested that design is more of a decision-making effort. Design activity is generally seen as a form of problem-solving (Johannes, 2000). Decision-making and problem-solving are so related to each other in so many different ways that it is impossible to consider them separately (Adair, 2017). "*The relationship of problem-solving with exploration, research and decision making makes it more important to acquire this skill in educational processes*" (Çimşir & Baysal, 2019, p. 340). Problem-solving improves students' creativity. When students participate in the process for the solution of the problem, they are involved in this process by revealing their creative ideas because the student discovers and researches. In this respect, problem-solving skills are highly related to creative thinking and decision-making skills.

Problem-solving is one of the mental processes, and there are different approaches to it. According to Schunk (1988: 99; et al. Baysal, 2003, p. 20), there are three problem-solving approaches (Çimşir & Baysal, 2019) which are (a) Exploration: it consists of examining the problems in this section, which are used to reach/collect information and data, planning, examining, analyzing, and evaluating data (Çimşir & Baysal, 2019); (b) Inquiry: this approach, which is used to produce knowledge and skills that are new to problem-solving itself, consists of the steps of identifying the problem, forming hypotheses, planning data collection, collecting data, examining data, analyzing and

evaluating, accepting/rejecting hypotheses, and generalizing (Çimşir & Baysal, 2019); and (c) Decision Making: this approach consists of the steps of determining the decision to be taken, planning the results and alternatives, generating the results and alternatives, examining the results, analyzing and evaluating, choosing according to a value system, and taking action. It helps the individual decide on one of the options in a situation (Çimşir & Baysal, 2019).

The stages of the problem-solving process are defined in different ways. According to Dewey (n.d.), they are based on five steps to recognize the problem. These steps formulate transient hypotheses, collect and organize data, explain data, achieve results, and test results. Michaelis (1985, p. 237) has been involved in solving problems with his research skills and has stated that his ability to solve the issues and research comprises the following stages (Çimşir & Baysal, 2019):

- Identify and define the problem
- State questions or hypotheses to guide data collection
- Collect and appraise data
- Answer each question or test each hypothesis
- Base conclusions on evidence

As for Evans and Brueckner (1990, p. 135), these stages are (Çimşir & Baysal, 2019):

- Define the problem
- Try a quick solution
- Gather data
- Process the data
- Analyze the data
- Formalize an answer

There are three forms of applied thinking that are needed: decision making, problem-solving, and creative thinking. Although there are areas of intersection between these forms, there are also different aspects from each other. Decision-making is about deciding what action to be taken, and it's often about choosing between options. The purpose of problem-solving is usually a solution, an answer, or a result. In contrast, the purpose of creative thinking is about new ideas (Adair, 2017).

2.2. BASIC DESIGN EDUCATION

"*It can be said that design is a result of the ability to think about something that does not exist*" (Akdemir, 2017). "*The design is generally defined as the process of preparing the diagrams or plans necessary for an activity. It can also be considered as the creative process itself*" (Düzenli et al., 2017, p.1451). The main emphasis of design education should not be on what the result to emerge, but on how the process and method work (Düzenli et al., 2017). The education process spent in basic design studios is aimed to transfer the principles and elements required for design based on practice. In this process, while students develop themselves, they gain the ability to work with different materials and textures, question themselves, and gain the ability to criticize (Felek, 2020). Design principles and elements help students develop their thinking skills since they aim to develop design skills regardless of material type or tool (Cindioğlu, 2019). In the continuation of the thesis, the element of 'color', which is included in design education and thought to be very important for design education, has been researched.

2.2.1. Color as an Element of Basic Design Education

Color is perceived due to the rays coming from the light source on objects. The effect of these reflected lights is relative to the different wavelengths that reach the brain. Color seems tangible in the physical environment, but it differs in size as light reflects surfaces (Sherin, 2012). Color is created based on the nature of the light source itself or the features of the impacted surface/object. It creates the emotion that humans feel when encountering a visual element and the effect left in the visual sense after experiencing various objects. Objects absorb some of the rays when exposed to them, and they reflect some others. The perceived color type is linked to the reflected says. If all rays are reflected, the color is white; if all are absorbed, it is black (Alıcı, 2019).

The eye transmits light vibrations to the brain through the nerves, allowing the color to be detected. Light is the first condition to see color. Therefore, there is no ability to see color in a non-light environment. Rays from the sun vibrate at different speeds, creating different wavelengths. The feeling of color in mind is nothing more than the effect of different wavelengths of light (Bigalı, 1984; cited in Çağlayan, 2018). In light, the wavelengths that affect the human eye vary from 390nm to 800nm (Alıcı, 2019).

The eye works in a camera-like way. However, two types of popular systems are working independently at the same time. Therefore, two different mechanisms work together for light-dark detection and color detection. The baronial cells, one of the two types of cells in the eye retinas, reflect from the objects to determine the amount of light coming from them. The cone cells in the retina capture the color characteristics of the light from the object (Zettl, 2015; cited in Çağlayan, 2018).

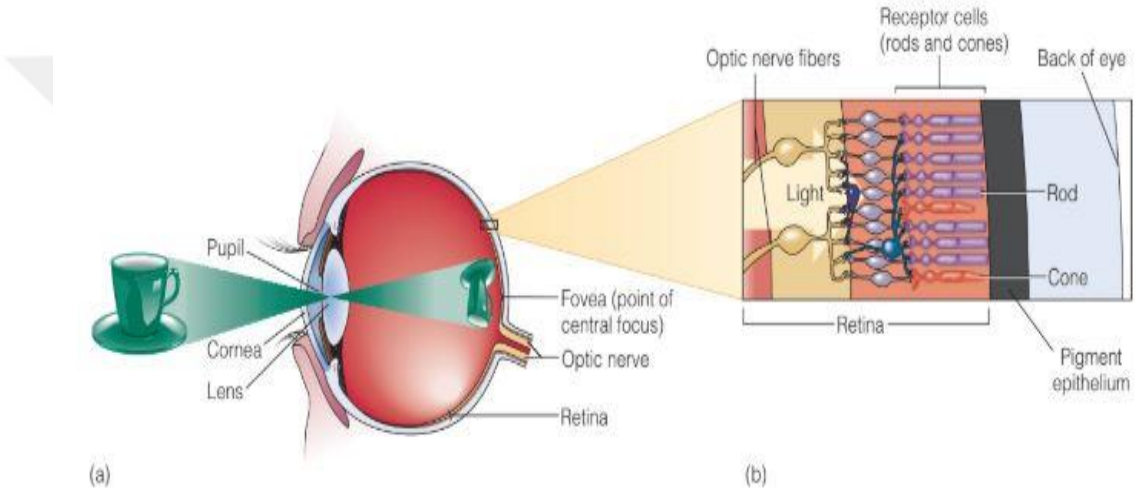

Figure 3: "An image of the cup is focused on the retina, which lines the back of the eye. The close-up of the retina on the right shows the receptors and other neurons that make up the retina."

(Goldstein, 2010, p.45)

There must be communication between the eye, light, and brain for the visual event to occur. In the vision process, the exposure of the rays to the eye is physiological; so is the processing of the eyes and the nerves. The signals transmitted to the brain after these operations cause a psychological effect to produce visual phenomena. In the event of any disruption in the stages that carry out this process, the visual event is disrupted and does not occur (Alıcı, 2019). Light is detected at the end of communication between the eye and the brain. Newton argued that white light was made of colored rays and did an experiment to prove it. In the darkroom, he managed to isolate the white light into its components with a prism that he held in a radial ray of sunlight, and the light through the

prism went out as a 7-color spectrum of light. As shown in Figure 4, these colors are purple, dark blue, blue, green, yellow is orange, and red. The primary colors of the eye are sensible, but the other separations occur in the brain. We get white light if we reflect the colors through the prism (Alıcı, 2019).

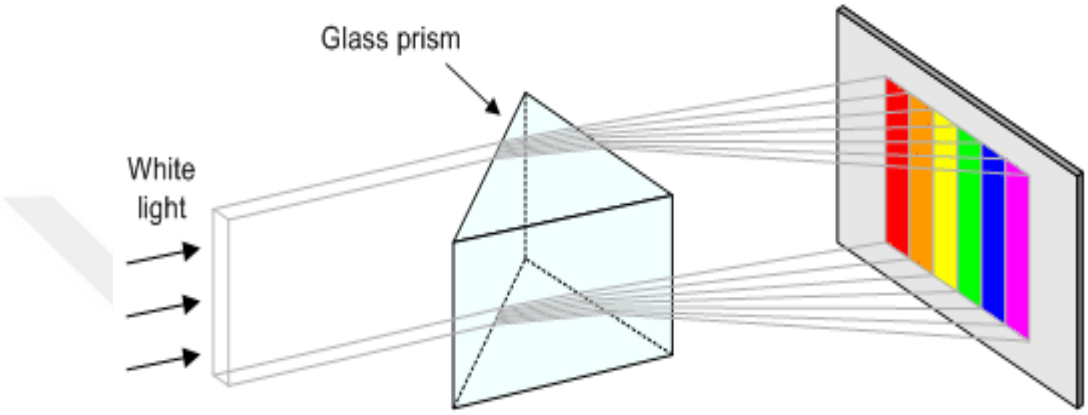

Figure 4: Newton Color Prism Experiment.
https://www.pinterest.es/pin/329677635203133116/

Colors can be categorized according to their physical features: Hue, saturation, and brightness. Hue is the color reflected from the object or transmitted through the thing. It is measured as a position on the color wheel and is expressed as a degree between 0 and 360 degrees. It is defined by the name of the color, such as 'red, orange, green.' Violet has the shortest wavelength, and red has the longest wavelength (The Elements of Art and Principles of Design, n.d.). Saturation is the measure of color purity, which means how sharp or matte the color looks. It is also known as Chroma (The Elements of Art and Principles of Design, n.d.). As for Brightness, it refers to the darkness or clarity of color. The light field areas of an object are brighter than the areas in the shadow. Brightness is referred to as value (The Elements of Art and Principles of Design, n.d.).

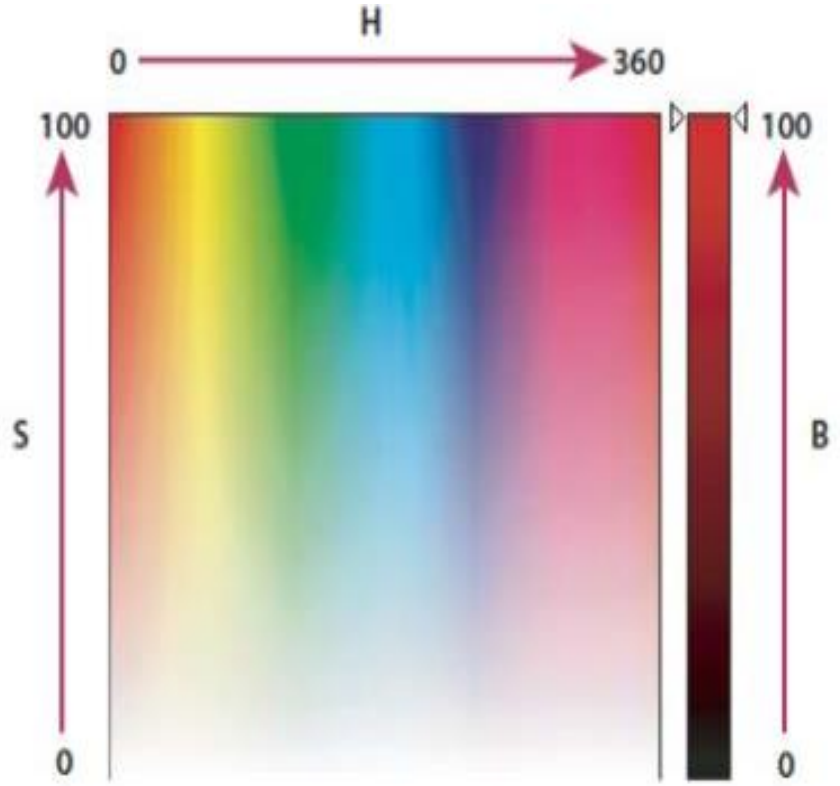

Figure 5: HSB Color Model: H. Hue, S. Stauration, B. Brightness.
http://www.coskuncanli.com/renk-teorisi/

Colors are divided into achromatic and chromatic colors, depending on the light they reflect. There are tonal transitions between black and white in achromatic colors. So the achromatic colors are colors that are not color-capable. Chromatic colors are called a colorway that make up the color. The colors are grouped according to their relationship. The Main and Intermediate colors are Primary colors: Red, yellow, and blue. A mixture of other colors does not obtain these colors. The intermediate colors are orange, green and purple, and these colors are made up of a mixture of the main colors as shown in figure 6: Orange (red + yellow), green (yellow + blue), purple (red + blue) (Doğan, 2020).

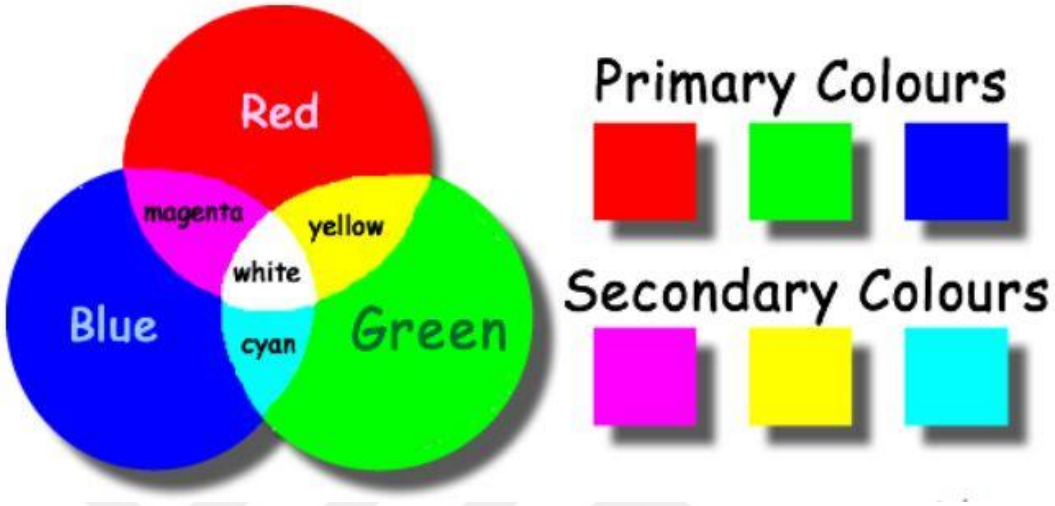

Figure 6: Primary Colors and Secondary Colors.
https://www.cyberphysics.co.uk/topics/light/colorAddition.html

Complement or integral colors are colors that are opposite each other on the color wheel. They produce complete colorless results when used together. The combination of three primary colors (red, yellow, blue) results in the whole coloration. If paints are used to achieve full colorlessness, black is achieved; if the light is used, full colorless is achieved. Analog colors are adjacent colors on the color wheel. Achromatic colors are white and greyscale when used to represent colors, whereas black is represented as colorless. Triadic colors are cyan, magenta, and yellow colors. Finally, monochromatic colors are those unique in the hue of the same color.

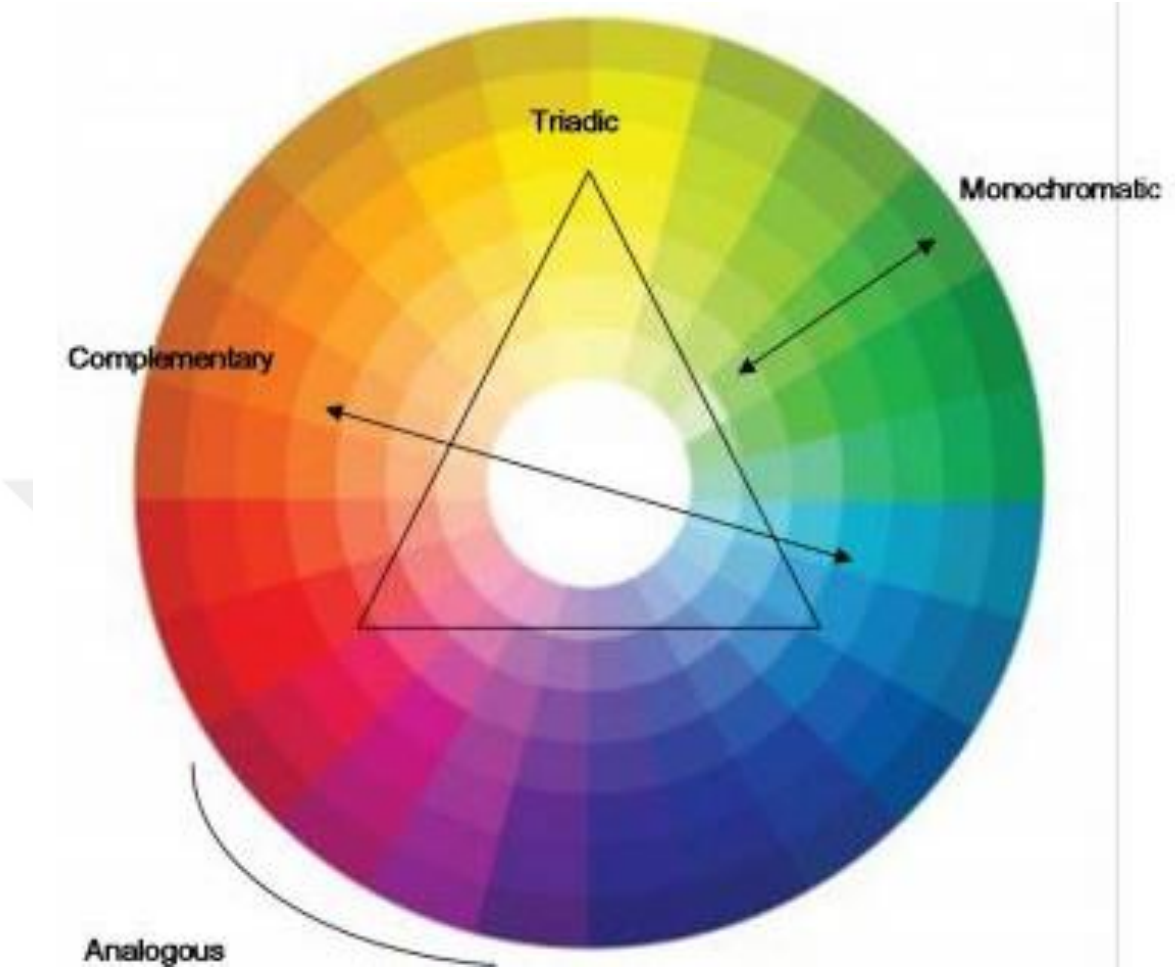

Figure 7: "The Color Wheel Describes the Relationship Between Colors."
(The Elements of Art and Principles of Design, n.d., p. 18)

Furthermore, colors are divided into two groups: warm colors and cold colors. As shown in (Figure 8), the colors that make up the warm color group are 'red, orange, yellow,' and the colors that make up the cold color group are 'green, blue, purple.' Warm colors are colors with high wavelengths in the color circle, and cold colors have low wavelengths in the color circle.

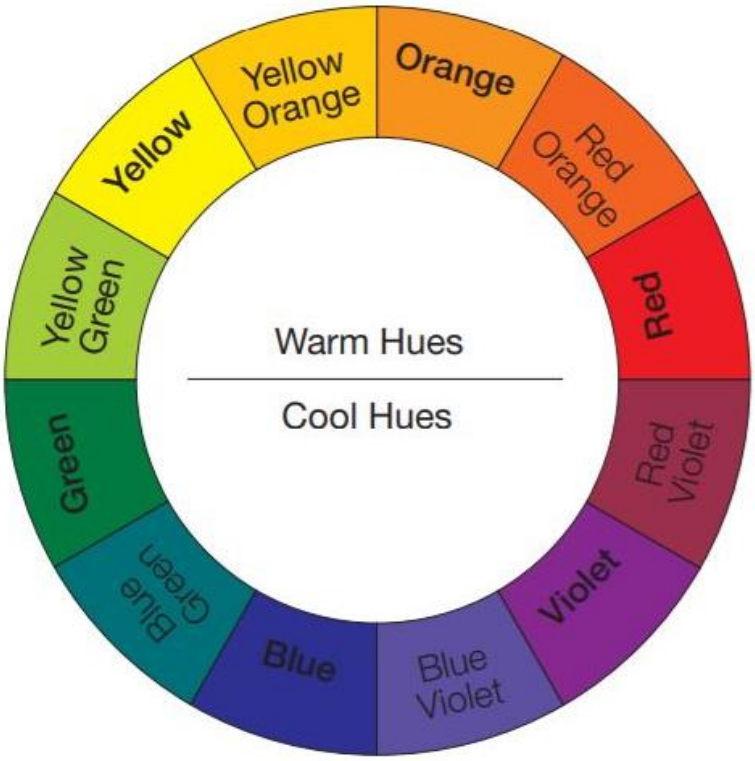

Figure 8: "Basic color wheel: This diagram of a basic color wheel provides an excellent reference tool to see the relationships between colors when working on design projects." (Sherin, 2012, p. 18)

The colors that are mutually intertwined in the color circle are called contrast colors. Color contrast is determined by the amount of saturation of colors and the intensity of light. The color harmony is the consistency between colors—their connection. Colors that are close together in the color circle complement each other's effects, thus creating harmony.

The side meaning of the design is defined as the combination of visual elements. Compositions are produced by integrating various visual elements and forming the basis of design disciplines (Bowers, 69; cited in Akbay, 2003). Design elements and principles are essential for visual compositing. In Basic Design education, design elements are components or parts defined in the design. The designer uses these visual tools to compose. These tools are organized using design principles to create a design. All design elements are components of visual communication, defined and examined independently, but they affect each other (Akbay, 2003).

The subjects that make up the essential content of basic design education are:

- Design elements**: (**point, line, shape, texture, value, and color)
- Visual perception: (organization principles, proximity, similarity, good shape characteristics, figure-ground relationships)
- Design Principles: (balance, hierarchy, pattern, rhythm, space, ratio, accent, motion, fit, contrast)
- Space, shape, geometry: (two and three-dimensional concepts) (Çağlayan, 2018).

The basic education in interior architecture education is the basic design studio. The topics covered in design education in these studios include 'color'. The reason is that the phenomenon of color is one of the main elements of design. Color in design is a flexible and powerful tool. It can be defined as a natural feature of all materials, from esthetics to functionality, as an inseparable element of design (Olguntürk & Demirkan, 2011). It is also known that color has psychological effects and is therefore, thought to impact on people emotionally. Thus, the designers need to use color consciously in their designs and they can communicate the emotion they want to give in their design through colors. Accordingly, color is considered to be an essential means of expression for design.

"Color problems are an excellent vehicle for developing a discriminating eye for color choice, composition and a greater understanding of what constitutes visual sensitivity."

(Sherin, 2012, p. 6)

''Subjective color combinations are a key to defining the individual's natural way of thinking, feeling, and doing. Helping a student discover their subjective shapes and colors is helping them explore themselves.''

(Itten, 1970, p. 24)

2.2.1.1. Color as a Design Element

"*The design elements are the components or parts which are defined in any design or work of art. They are the structure of a design or a composition and can carry a wide range of messages, which are the visual tools available to the designer and artist*" (Akbay, 2003, p. 8). Thus, visual elements form the most dominant part of a design (Akbay, 2003). Color from design elements is one of the most powerful tools a designer utilizes to communicate with users (Sherin, 2012). It is a combination of content, form, and ideas that come together in a design. The color and color relations that the designers use in their designs can also highlight the movement, depth, and point of interest in the design because the color can help the eye find the focus point (Dietrich, n.d.). "*Color may also be used to convey the intended spirit of a design*" (Dietrich, n.d., p. 21). Color usage is also linked to other design elements and principles (Dietrich, n.d.). When the color is used correctly, it can transfer the desired emotion in the design. When combined with the design elements of color design principles, the expression of visual composition may increase. Several examples of visual pieces transmitted in the combination of color and design principles are given. For example, the rhythm principle provides layout and unity in design. It is also possible to create the rhythm effect with color usage, as shown in (Figure 9). The use of rhythmic color ensures a combined and consistent effect.

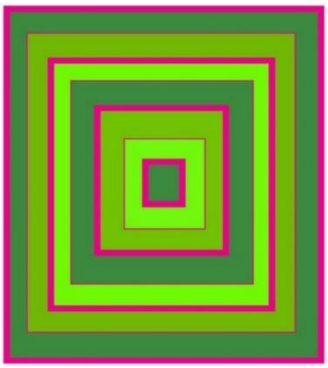

Figure 9: Use of Rhythmic Color.
https://www-dsource-in.translate.goog/course/visual-design-color-theory/color-design-principles?_x_tr_sl=auto&_x_tr_tl=tr&_x_tr_hl=tr&_x_tr_pto=ajax,se

In the example shown in Figure 10, the balance is related to the overall visual impact of all components together in a composition or design. Symmetry is the easiest

way to achieve balance. Although the ingredients in a combination are projected along the central axis, an asymmetric balance is achieved when the objects are placed in general to form a visual balance. The difference in color tone also emphasizes this visual balance.

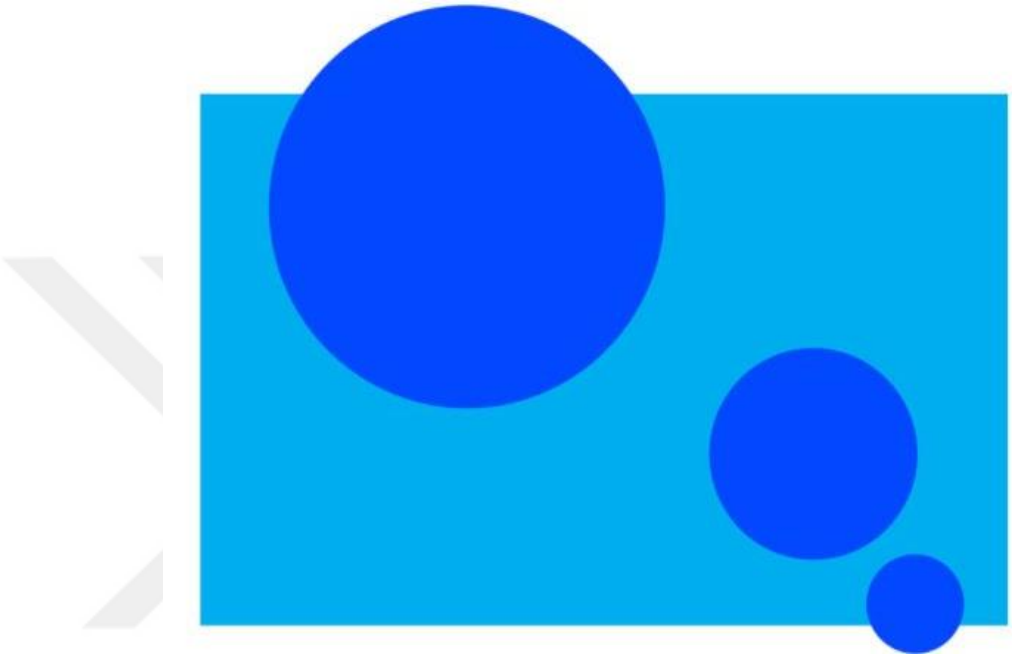

Figure 10: In the design, the principle of balance was emphasized with the difference in color tones.
https://www-dsource-in.translate.goog/course/visual-design-color-theory/color-design-principles?_x_tr_sl=auto&_x_tr_tl=tr&_x_tr_hl=tr&_x_tr_pto=ajax,se

Another example of using color in conjunction with design principles is the following: It is possible to highlight the concept of Ratio-Scale with tints and differences from design principles. The ratio is related to the relationship and overall impact between one part of a design and another part of the design. When looking at the scaling strategy and size relationship, the scale of the color used is evaluated in two ways. The color used in (Figure 11) is related to the amount of color used in a combination and the amount of surface area occupied by colors. Another application format is associated with the thickness of the color used as shown in Figure 12, and the scale effect on the overall composition.

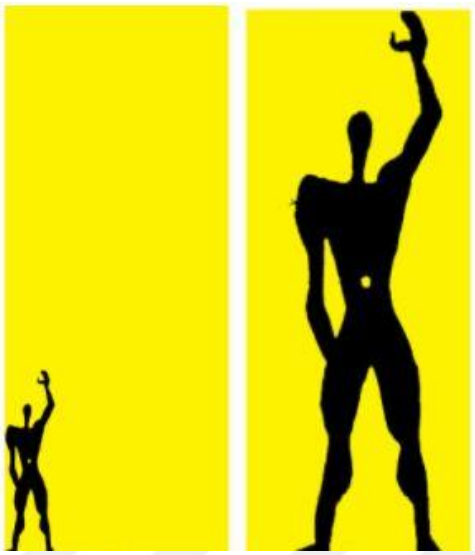

Figure 11: The ratio-scale relationship is shown by emphasizing the amount of color and the surfaces occupied by the colors.

https://www-dsource-in.translate.goog/course/visual-design-color-theory/color-design-principles?_x_tr_sl=auto&_x_tr_tl=tr&_x_tr_hl=tr&_x_tr_pto=ajax,se

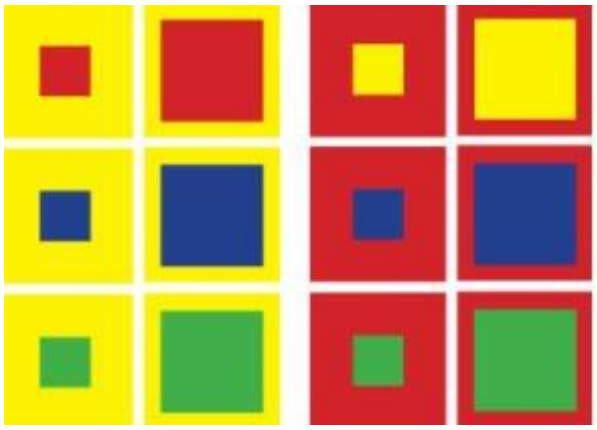

Figure 12: The ratio-scale relationship is shown with the thickness of the colors used and the overall composition effect.

https://www-dsource-in.translate.goog/course/visual-design-color-theory/color-design-principles?_x_tr_sl=auto&_x_tr_tl=tr&_x_tr_hl=tr&_x_tr_pto=ajax,se

It is possible to attract the attention of the audience with color since it can be used to accentuate a design. As shown in Figure 13, it is possible to emphasize the desired area in the design by using a color other than the color tones used in the general composition.

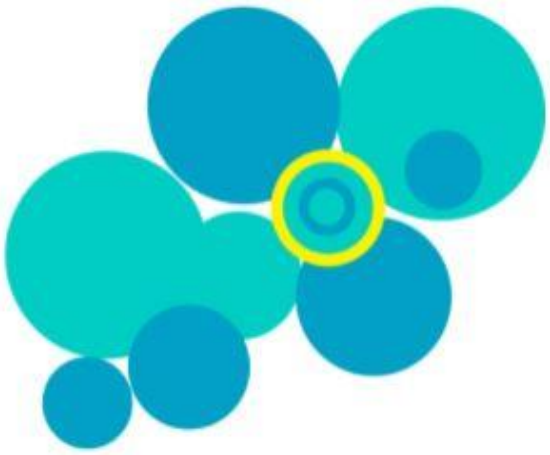

Figure 13: While the general color scale of the image consists of colors close to each other, a point in the image is emphasized with yellow color.
https://www-dsource-in.translate.goog/course/visual-design-color-theory/color-design-principles?_x_tr_sl=auto&_x_tr_tl=tr&_x_tr_hl=tr&_x_tr_pto=ajax,se

Color is considered a design element with objective, scientific, visual, formal, and functional attributes in design. At the same time, it has its own internal, intuitive quality and is defined as subjective. "According to Green-Armytage, the successful color design depends on the design's own experience, but it also depends on the designer's knowledge" (Ural et al., 2017). Aesthetic judgments, associations, feelings, preferences, likes, and dislikes will affect the color choices that the individual uses in their designs. Culture is also an influential factor in creating individual color choices in education, age, gender, and past acquired experiences (Ural et al., 2017). "*It has been highlighted in many studies where these experiences are effective whether the individual is aware or not of color choices. It is an observable fact that color plays an effective role in interpretation*" (Delong & Martinson, 2012, p. 82). Effective color blending strategies create a strong visual impact. Meaningful color communication increases the readability of the product and the effectiveness of the message (Delong & Martinson,2012). Color perception is the

prerequisite for seeing. We visually detect the form by color. It helps us distinguish between color contrasts, borders, and edges (Delong & Martinson, 2012). Color is a visual experience (Hemani et al., n.d.). If everything in the surrounding world had the same color tone and nuance, we wouldn't distinguish one thing from another (Delong & Martinson, 2012). To see is to detect visual differences and similarities. The purpose of color perception is to notice color separations and similarities. Without that kind of difference, the concept of color would have no meaning (Delong & Martinson, 2012).

"The perception of color is the single most strongly emotional part of the visual process. Our reactions to color are often strong and immediate, and we associate the most diverse experiences and emotions with colors" (Lowry, 52; cited in Akbay, 2003, p.7).

2.2.1.2. Color in Visual Analogy

The use of analogy allows an unknown situation to be understood by a connotation of a familiar situation in terms of meaning (Casakin, 2010). The main system defines analogies according to mapping theory (Gentner, 1983; cited in Casakin, 2010). Information transfer is achieved through analogy mapping, so relationships about central features are transferred from a target base. Identifying the similarity between probability leads to an analogy of relations in the target state and known relationships in the source state (Casakin & Goldschmidt, 1999). The operations of the analogy consist of several steps. As shown in (Figure 14), the mind receives the necessary information, codes it, decides where to transfer it, and records it. The sequence of the analogy is given in the diagram below (Yaner & Goel, 2006).

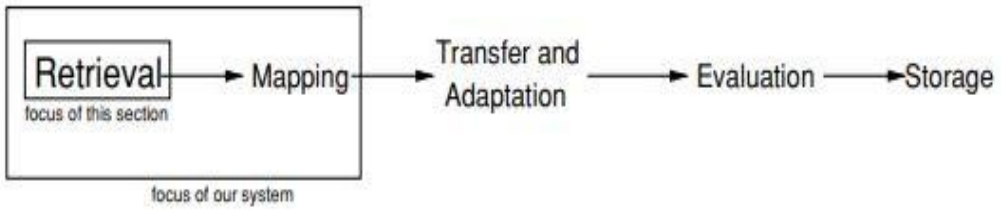

Figure 14: ''Task of Analogy''

(Yaner & Goel, 2006, p. 92)

Psychological studies show that visual reasoning often occurs in analogy (Pedone et al., cited in Davies & Goel, 2001). Visual reasoning tools are essential for analogy since half the brain is devoted to the visual sense. It has an excellent capacity for graphic patterns, shapes, and colors; and has the ability to interpret those in various ways. Perception is an active process. We look for the information we need with eye movement. Whenever the eye stops, it processes patterns into memory and chooses the most appropriate one when necessary (Ware, 2008).

In design education, developing design problem-solving skills is one of the challenges of design education. Using visual information in design education is very useful for designers. The use of pre-information to solve new design problems is considered to be convenient for designers. In the early stages of the design process, a visual analogy is a powerful strategy for developing problem-solving. Because with visual images, designers can benefit from a wide range of products. It also shows that visual analogy in studies increases the design quality (Casakin & Goldschmidt, 1999).

Designers in all disciplines live in a very visual world. Visual information is often foreground for designers in the design process. Designers are often advocated for visually thinking because designers' tools to think are usually made up of shapes and forms rather than verbal ones (Goldschmidt & Smolkov, 2006). The color is considered to be very important for these vehicles. Color perception occurs in a combination of physical, physiological and psychological environments, depending on the light, object and physiological and psychological characteristics of the observer (Sarıca, 2011). Colors make sense based on the perception of individuals. In visual detection size, the primary element of visual language and visual communication is indicated as colors; while a visual indicator is also emphasized as the primary element of color and the attention of the image arrow (Zeybek, n.d.). Colors are sometimes used to create a more substantial impact or create visual attention, and sometimes to make the image easier to read or show the type of product in the image (Zeybek, n.d.).

The effect of colors on people is relatively straightforward, and a lot of experimentation is being discussed regarding this issue. Colors have psychological effects. These effects can vary from person to person and even among cultures. The psychological effects of colors can vary by character, tradition, culture, and society. Color

choices and tastes differ from person to person. This is common in everyday life in our clothes, home decorations, and personal preferences highlighted in the selected object's color. Each color has a different psychological effect on the person, and a favorite color may not be liked by someone else (Atik, 2019). Therefore, in design studies, the feeling of color in people may vary.

Colors have many psychological effects: warmth, coldness, activity, passivity, size, smallness, heaviness, lightness, joy, and sadness. These vary according to their temperature, saturation, type, and value. They also have physiological effects such as affecting breathing, heart rate, blood pressure. Nowadays, experiments have proven these effects (Ulaş, 2002; cited in Sarıca, 2011). For example, A. Ketcham has confirmed that the space between two blue cars in the parking lot seems more comprehensive than it is (Kıran, 1986; cited in Sarıca, 2011). In another experiment, the same researcher proved that a brown-painted box felt heavier than a box of the same size but painted yellow. Another study found that the red color increases the speed of body movement and, consequently, the loss of balance and vision delusions. These abnormal conditions are considerably reduced when using light green (Kıran, 1986; cited in Sarıca, 2011).

With all of these color and visual perception features, it is believed to be a significant and essential element in the design process. The design process begins with the designer learning a new piece of information. The designer faces a problem and refers to a suitable source of ideas to solve this problem (Hey et al., 2008). The importance of visual analogy as an inspiration within designers has been highlighted in the studies. The color of the visual images is highlighted in the studies that are considered critical to catching persistence and attention. In visual images, colors are considered to be very important in mind-being. Thus, in visual analogy, colors are thought to have a significant benefit as an inspiration for design studies. In the rest of the research, a study was conducted to measure the effect of color on the design process. Visual demonstrations, in the analogy are beneficial for creativity in designs (Casakin, 2010).

2.2.2 Color and Design Thinking Process

Basic design education can be defined as all educational activities carried out to express one's feelings, thoughts, and impressions and bring talent and creativity to an aesthetic level (Erbay, 2000; cited in Çağlayan, 2018). This education aims to provide individuals with knowledge about design principles and elements and develop their ability to make original designs using these principles and elements.

Design education, especially the introduction to design education, aims to teach students the design elements and basic principles by reasoning and creating aesthetic reactions. Design elements and principles are essential for visual communication (Ural et al., 2017). As one of these visual communication elements, color is an effective tool for designers to express themselves and reveal originality. In this thesis, a study was conducted to determine whether there is an effect of color on design thinking process in the design process.

CHAPTER II

3. METHODOLOGY

The methods of this research, sampling, data collection tools, and data analysis techniques are presented in this section.

3.1. SCOPE OF THE STUDY

Interior Architecture Education at Çankaya University is where this research was conducted. It covers 54 courses completed in eight semesters. The first year of education is given with INAR 101. As a continuation of this course, the second semester of the first year INAR 102 (Introduction to Interior Design) is given. These two related courses are required in the course curriculum.

The Basic Design course (INAR 101) in the first semester of design education is eight hours a week in a 14-week academic period. This course, which adapts the basic ideas and principles of the Bauhaus approach and the Gestalt perception Principles, covers identifying information about design topics. The course content generally consists of critical factors such as design elements, concepts, and design principles. In addition, this course covers the production of special designs, the creation of solutions to design problems, the development of mental and hand skills, the ability to create two- and three-dimensional spatial compositions in different environments, and the ability to brainstorm and use visual values at the same time. The course contents are meant to initiate the visual and verbal design language ability and gain abstract thinking capability. Furthermore, it is designed to introduce geometric definitions and relationships through discussing the conceptual, visual, relational, and orthotic elements of basic design.

The course provides detailed information about color usage in design principles by introducing the design elements and concepts. Thus, it implements the transformation of two-dimensional structures with three-dimensional organizations.

Students who complete this course are expected to use basic design elements and principles to create a visual language to restructure their subjective and perceptual experiences with the environment. At the same time, students are expected to communicate their perceptual experience in a verbal language for their later work. Students are also expected to be able to use their spatial organization in their projects both verbally and visually and to have the ability to analyze and design spaces. These are known to be fundamental knowledge to the INAR 102 course and other studios.

The INAR 102 course is the continuation of the course of INAR 101 but contains spatial elements. This studio-based course focuses on project work and experience. Course processing, design problems/projects, research, course narratives move in the form of 'pin up' critics and juries. The main purpose of this course, which is in the form of studio teaching, is to teach creative thinking and design. The course is regarded as an introduction to interior design by creating spatial solutions, considering the human dimensions and distances, spatial planning apertures, and including natural lighting and functional organizations. Thus, it involves developing mental and hand skills.

Students who complete this course are expected to discuss and analyze human dimensions and design for human needs and requirements. Students are expected to work out the ratio and scale to solve the problems of spatial functionality in interior design. In addition, students are expected to define and design spaces using public spaces by providing an understanding of the space and spatial organizations. Thus, they are expected to provide a solution for the information they have learned and any situation they may encounter in the design process. All these gains are known to be very useful to students for their projects in other studios.

The course in which design elements and principles are processed is the INAR 101 course. Starting to use color in design problems where basic color information is given is included in the course content. Students of INAR 102 are thought to be more familiar with the concept of color as the ability to design is already gained in INAR 101, and the color

is learnt accordingly. For this reason, the study was carried out during the INAR 102 course period, which is the continuation of INAR 101.

3.2. RESEARCH QUESTIONS

This research includes the following questions:

- What is the effect of color on the design process in basic design courses?
- What is the effect of color in the problem-solving process?
- What is the effect of color in the creative thinking process?
- What is the effect of using color in the design process?

3.3. PARTICIPANTS

The study was conducted with the participation of INAR 102 students at Çankaya University. A total of 64 students, including 39 female and 25 male, participated in the study. The age range of the participants varies between 18-29. Most participants were found to be around 20-21 years old.

3.4. QUESTIONNAIRE

The questionnaire consists of demographic questions, one general question, and a total of 20 questions grouped under four headings, divided into five groups. Twenty questions were prepared based on a 5-point Likert scale (1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree).

The general question and 20 questions in the questionnaire are taken and adapted from Hasırcı's master's thesis on ‘The Effects of the Design and Organization of Learning Environments on Creativity: The Case of Two Sixth Grade Art-Rooms’ (Hasırcı, 2000) and the doctoral thesis ‘Understanding the Effects of Cognition in Creative Decision-Making: A Creativity Model for Enhancing the Design Studio Process’ (Hasırcı, 2005).

The questionnaire started with the demographic questions. This section contains questions about age, gender, vision disorder (which visual tool they use, if any), and color blindness.

After demographic questions, there is a general question. The question asked ‘If you consider the design process, what would be the percentage of color in this process’.

Additionally, it has a question prepared for students to understand the location/importance of the color element used in the design process. The questionnaire included 20 questions gathered under the following categories:

-Color Decision in Design Process: Under this category, questions are prepared to examine whether color decisions contribute to the design process. These questions are also the questions that are prepared to determine whether the color decisions taken in the design process can help the design process move more smoothly and easily.

-Color in Problem Solving Process**:** In this category, where the effect of color is investigated during the problem-solving process, it is examined whether the color element helps students. This section also provides questions to explore whether they can highlight color and design problems, use color to draw attention to design problems, and produce different solutions to color and design problems.

-Color in Creative Thinking Process: This category is prepared to review whether color contributes to the creative thinking process. It is also intended to examine whether the color element used in the design process with these questions contributes to developing the student's creativity. The questions also intended to understand whether creative thinking can contribute to the development of design thinking. This was to examine whether the color has contributed to students' original design work.

-Color Usage Design Process: This category also contains questions to help understand whether color usage contributes to the design process.

3.5. PROCEDURE OF THE STUDY

The study, conducted within the scope of the INAR 102 studio students, was done using computers due to the COVID-19 pandemic during online distance education. The questionnaire was sent to students as a Google Form document. An online meeting was held where the questionnaire was explained to the students and asked to answer individually. Students were given 20 minutes to answer the questionnaire.

3.6. DATA ANALYSIS

The data obtained in this study has been analyzed with the IBM SPSS Statistics-Version 26.0 program. Normality testing was performed to see if the data matched the

normal distribution. Kolmogorov Smirnov and Shapiro Wilk were used for these tests. As a result of the test, the data were not normally distributed; thus non-parametric tests were used for the data analysis (see Appendix, Table 10). For the analysis, mean and standard deviation statistics were used to determine the participants' rating tendencies to the questions, Spearman's rho correlation coefficient was utilized to examine the relationship between variables and Wilcoxon signed-rank test was used to explore the difference between two dependent variables.

The analysis of the data by using these methods was done with a confidence interval of (p= 0.05). Thus, if the P-value is less than 0.05, it is statistically significant. As the P-value decreases, evidence of statistically significant differences increases. The reliability of the 20 tested items (N = number of tested items) in the survey study was tested by Cronbach's Alpha coefficient method. The Cronbach alpha coefficient is a coefficient that best reflects the overall reliability structure over other coefficients, as statistical foundations are consistent and calculated with all questions in mind. According to this test, the alpha coefficient is indicated by 'α' and receives values between -1 and +1. The resulting alpha coefficient is interpreted as fooling:

	Is Not Reliable	Low Reliability	Medium Reliability	High Reliability
r=	$0.00 \leq \alpha < 0.40$	$0.40 \leq \alpha < 0.60$	$0.60 \leq \alpha < 0.80$	$0.80 \leq \alpha < 1$

The scale is highly reliable because the output result ($0.80 \leq \alpha$ 1) is within the range. As shown in Table 1, this survey shows the plausibility test result (0.946). This indicates that the scale was highly reliable.

Tablo 1: Reliability test results of 20 questions of the survey study.

Cronbach's Alpha	0.946
N of Items	20

CHAPTER III

4. RESULTS AND DISCUSSION

This section presents and discusses the statistical analysis of the collected data. The 20 questions in this study were analyzed using the Mean and Standard Deviation Statistics. Answers were obtained by using the Likert scale as the following:

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Spearman's rho correlation was used to measure the relationship between the question titles in the questionnaire. The Wilcoxon signed-rank test was used to differentiate the question titles. The findings were interpreted in the general discussion section.

4.1. DESCRIPTIVE ANALYSIS

The study conducted with the participation of 64 students. The analysis carried out in the demographic questions section found that 35 students had no visual impairment, and 26 had visual impairment. Students with visual impairment stated that they had astigmatic and myopia. These students stated that they use lenses and glasses as the tool they use to correct visual impairments. Three students left this question blank. The question of whether students had color vision disorder had been answered 'no' from all students. All students were not diagnosed with color vision impairment. The survey also

included the color blindness test and found no color blindness in any of the students based on the answers received. Whether students had any interest in color before their education at Çankaya University had answered ‘no’. Only about 9% of the students were determined to have their color-related efforts before studying at the Department of Interior Architecture.

The general question of the questionnaire was, “"If you consider the design process as a whole, what would be the percentage of color in this process”. The answers were given as follows:

- Less than 30%
- Between 30% to 50%
- 50%
- Between 50% to 70%
- More than 70%

Table 2: The results of the Mean and Standard Deviation Statistics of the data obtained from the general question in the questionnaire.

If you consider the design process as a whole what would be the percentage of color in this process.	
Valid (N)	64
Missing (N)	0
Mean(M)	3.06
Std. Deviation (SD)	1.320

The average of the data obtained by the analysis carried out was *M*=3.06, and the standard deviation was *SD*=1.320 (Table 2). This data has been found that students generally think it covers 50% of the color in the design process. This result suggests that color is one of the critical elements for the design process, covering half process in the design process.

The data obtained from the student responses from 20 questions collected under four topics, each consisting of 5 questions, is discussed in the following section.

4.2. COLOR DECISION IN THE DESIGN PROCESS

As Demirbaş and Demirkan (2003) suggest, the design should not be considered the emerging product; instead, it should be regarded as the process of various stages to expose the product. The process students spend until they reach the final product is called the design thinking process. Students are known to use the color element of design elements in many projects during the design process. In this section, "the effect of the formation of color decisions during the design period" is investigated. The analysis of the data from questions and students' answers is given in Table 3.

Table 3: Mean and standard deviation results of the data obtaining from the 'Color Decision in the Design Process' category.

Color Decision in Design Process	**Valid (N)**	**Missing (N)**	**Mean (M)**	**Std. Deviation (SD)**
1. In my opinion, my work progresses more easily when my color decisions become clearer in design.	64	0	3.84	0.859
2. When I start designing by contemplating about color, I have a more enjoyable time during the process.	64	0	3.69	1.006
3. When I think about my work including color during the design process, I can add new meanings/ concepts to my project.	64	0	4.19	0.906
4. In my opinion, my decisions on various colors might produce alternative solutions for my design.	64	0	4.05	1.015
5. During the design process, I construct my color decisions upon the colors I like.	64	0	3.50	1.208

In line with the analysis, it was determined that 64 students answered all the questions without leaving any blanks. As for the analysis made for the question ‘In my opinion, my work progresses more easily when my color decisions become clearer in design’, the mean was *M*=3.84, and the standard deviation was *SD*=0.859 (Table 3). In line with the data obtained, it is seen that there is a tendency towards the answer "agree" among the marked options. This indicates that students improve their work more easily when color decisions about design begin to occur.

Regarding the question “When I start designing by contemplating about color, I have a more enjoyable time during the process”, the mean was *M*=3.69, and the standard deviation was *SD*=1.006 (Table 3). As in the previous question, these obtained data show that the option marked in this question mostly tends towards "agree". The fact that the majority of the students answered with “agree” with this question shows that the students' opinions are that color helps them have a more enjoyable design process. In line with the answers from the students in this question, it can be said that colors help the design process to proceed more efficiently by causing the design process to be enjoyable.

The next question analyzed was, “When I think about my work including color during the design process, I can add new meanings/ concepts to my project”. It was found that the mean *M*=4.19 and the standard deviation *SD*=0.906 (Table 3). This result shows that, as in the data obtained from the other two questions in the category, most students marked the option "agree". Based on the students' opinions on this question, it can be said that the use of color adds a new meaning/concept to design products/projects.

The analysis of the question “In my opinion, my decisions on various colors might produce alternative solutions for my design” had a standard deviation of *SD*=1.015 (Table 3). As in all previous questions, there is a tendency towards the option of "I agree" in the responses of the students in this question. These data, obtained in line with the responses from the students, show that color decisions help produce different solutions for the design problem. At the same time, this result suggests that color decisions help to reveal new ideas for the design problem.

In line with the analysis made in the question “During the design process, I construct my color decisions upon the colors I like”, the mean was *M*=3.50, and the standard deviation was *SD*=1.208 (Table 3). The result shows that the students' opinions

are mainly in the direction of "agree", as in all other questions in the category. In line with these data, it is seen that the students mostly made their color choices based on their likeness during the design process. In line with this result, students generally use their prefered colors in their design studies.

In this part of the study, according to the answers from students, color decisions in the design process can be found to have a positive impact on the design process. The majority of responses are in the direction of ‘agree’. While color decisions in the design process contribute, the results also suggest that color decisions are essential for the design process. As Olguntürk and Demirkan state, color is a flexible and powerful tool in design. Color can be considered an inseparable element of design (Olguntürk & Demirkan, 2011).

4.3. COLOR IN THE PROBLEM-SOLVING PROCESS

For every design, there is a problem that needs to be solved at the beginning. The designer starts the design by solving this problem at first. With this stage, the design process begins. In this section of the study, questions prepared to examine the impact of color on problem-solving were designed. The questions used and the data analysis are given in Table 4.

As in the previous question group, it was found that 64 students answered the questions in this part of the survey without leaving any blanks. The mean was M=3.66, and the standard deviation was SD=0.979 according to the analysis in question “I can produce several solutions to a problem using color in my design” (Table 4). This data shows that most answers were towards ‘agree’. This result shows that students can often produce a few solutions to the design problem when they use color. This suggests that color is an important design element for producing alternative solutions.

The mean and standard deviation of the question “During the design process, if my design process gets to a halt, I can change my color decisions and create new/ alternative solutions” were M=3.41 and SD=1.178, respectively (Table 4). Unlike the previous question, these data showed a tendency towards the "neutral" option from students. The findings obtained from this question indicate that when the students had difficulties in the design process and did not know how to proceed with the given design problem, they were hesitant to produce new solutions to the design problem by changing the color decisions.

However, the means between M=3.41 and M=3.50 show that it was close to the “agree” option. This suggests that the design's expression, language, and emotion can be changed by changing the color in solving a design problem.

Table 4: Mean and standard deviation results of the data obtaining from the ‘Color in the Problem Solving Process’ category.

Color in Problem-Solving Process	**Valid (N)**	**Missing (N)**	**Mean (M)**	**Std. Deviation (SD)**
1. I can produce several solutions to a problem using color in my design.	64	0	3.66	0.979
2. During the design process, if my design process gets to a halt, I can change my color decisions and create new/ alternative solutions.	64	0	3.41	1.178
3. I know that I can make the emphasis I want to make in solving the design problems with color.	64	0	4.23	0.831
4. In my opinion, I draw attention to details with color differences in my design.	64	0	4.33	1.009
5. In my opinion, I can improve the usage of the material by using the same material with different colors.	64	0	4.11	1.025

In line with the analysis made for the question “I know that I can make the emphasis I want to make in solving the design problems with color”, the mean was found to be *M*=4.23 and the standard deviation *SD*=0.831 (Table 4). This result shows that the students' opinions were predominantly in the direction of "agree". These findings indicate that students made the emphasis they wanted in design problems using color. According to the students' answers, it can be said that color is used as a remarkable tool for the design product.

Regarding the question “In my opinion, I draw attention to details with color differences in my design”, the mean was found to be *M*=4.33, and the standard deviation was *SD*=1.009 (Table 4). This result shows that the opinions of the students of this question were in the direction of "agree". These data indicate that students draw attention

to the details in their designs by making different choices in the colors they use. This question suggests that the color differences used in the design problem are an attractive feature.

The survey study results in this part of the research show that most of the students' opinions were in the direction of “agree”. However, in the question “During the design process, if my design process gets to a halt, I can change my color decisions and create new/ alternative solutions”, it was seen that the students' opinions were generally “neutral”. However, it is noteworthy that the mean *M*=3.41 in this question was close to the option agree. Generally, the findings suggest that the color element contributes positively to the student in the problem-solving process, these results emphasize the fact that “The designer can draw attention to his design with color. The color and color relationships used by the designer in his design can also emphasize the movement, depth, and point of emphasis in the design” (Dietrich, n.d.).

4.4. COLOR IN THE CREATIVE THINKING PROCESS

The design process can also be thought of as the creative thinking process of the designer. Students are expected to develop original and new ideas at the end of this process in design education. The questions prepared in this part of the questionnaire are about the relationship between color and creativity. The analysis of the data obtained from the questions and students’ opinions in this section, where the effect of color on the creative thinking process is investigated, is shown in Table 5.

As in the previous question groups, it was determined that 64 students answered the questions in this part of the survey without leaving any blanks.

In line with the analysis made in the question “In my opinion, I can produce a more creative product/ work than my studio peers with color decisions in my design”, the mean was *M*=3.46, and the standard deviation was *SD*=0.964 (Table 5). These data show that students' opinions tended towards the option of "neutral" in this question. With the data obtained in this question, it is seen that the students were neutral about whether they produce a more creative product with their color decisions than their other studio friends. However, it is noteworthy that this result was very close to the option I agree with *M*=3.50.

For this reason, the color decisions made by the students contribute positively to the creation of creative design products compared to other studio friends.

Table 5: Mean and standard deviation results of the data obtaining from the 'Color in the Creative Thinking Process' category.

Color in Creative Thinking Process	**Valid (N)**	**Missing (N)**	**Mean (M)**	**Std. Deviation (SD)**
1. In my opinion, I can produce a more creative product/ work than my studio peers with color decisions in my design.	64	0	3.46	0.964
2. In my opinion, color inspires me more than other design elements in the design process.	64	0	3.44	1.139
3. In my opinion, when I use the same material with other colors, I can advance my design without the need for a new material.	64	0	3.38	1.062
4. I believe that color enables me to think in a versatile way in the design process.	64	0	3.95	1.015
5. In my opinion, color guides me to produce creative designs in the design process.	64	0	4.00	1.039

For the question "In my opinion, color inspires me more than other design elements in the design process", the mean was *M*=3.44, and the standard deviation was *SD*=1.139 (Table 5). As in the previous question, it is seen that the opinions of the students in this question were in the direction of "neutral". The data obtained from this question, in which the students stated that they were mostly neutral about the color inspiring more than other design elements, had a value very close to the option "agree" *M*=3.50, as in the previous question. In this direction, color can inspire more than other design elements in the design process in some design problems.

In line with the analysis made in the question "In my opinion, when I use the same material with other colors, I can advance my design without the need for a new material", the mean was *M*=3.38, and the standard deviation was *SD*=1.062 value (Table 5). As in

the first two questions in the category, the students' opinions were toward the "neutral" option. However, in this question, as in the other two questions, the value was close to “agree” *M*=3.50. In line with these findings, the design process can be improved by making color differences in the same material in some design studies.

As for the question “I believe that color enables me to think in a versatile way in the design process”, the mean was *M*=3.95 and the standard deviation *SD*=1.015 (Table 5). According to the first three questions in this category of the survey study, the findings obtained in this question differed, and the most marked option by the students was "agree". These obtained data show that students thought multi-dimensionally when they used color in the design process. This result suggests that color helps students look at design problems from different perspectives in the design process.

In line with the analysis made in the question “In my opinion, color guides me to produce creative designs in the design process”, the mean was *M*=4.00 and the standard deviation *SD*=1.039 (Table 5). Similar to the previous question, it is seen that there was a tendency towards the option of "agree". These data show that color helps to reveal creative designs during the design process. It also suggests that color contributes to creative thinking in the design process.

According to the analysis made, it was found that the students' opinions were neutral in the first three questions in this part of the survey study. However, it was noted that the rate of students who stated that they were neutral was very close to the rate of students who preferred the option to “agree”. In the other two questions in the category, students' opinions were in the direction of “agree”. In line with these findings, the students believed that the contribution of color to the creative process is positive. Casakin (2010) emphasizes that visual representations are very useful in terms of creativity in designs. The results obtained from this part of the questionnaire suggest that color, one of these visual tools, contributes positively to developing creative thinking ability.

4.5. COLOR USAGE IN THE DESIGN PROCESS

In this section, which is the last part of the survey, "The effect of the use of color in the design process on the design process" was investigated. The analysis of the data obtained from the questions and student opinions is given in Table 6.

Table 6: Mean and standard deviation results of the data obtaining from the 'Color Usage in the Design Process' category.

Color Usage in Design Process	Valid (N)	Missing (N)	Mean (M)	Std. Deviation (SD)
1. In my opinion, the most enjoyable activities in basic design education are color-related ones.	64	0	3.41	1.178
2. In my opinion, the use of color in basic design process contributes to my creativity.	64	0	3.88	1.120
3. When I use color in my design, I am able to complete the design process more smoothly.	64	0	3.44	1.022
4. When I use color in my design, I can complete the design process more fluidly/ quickly.	64	0	3.14	1.180
5.I think creating a color scale/ palette in my design, improves the design process.	64	0	3.98	1.105

As in all question groups, it was determined that 64 students answered all questions without leaving any blanks.

In line with the analysis made in the question of "In my opinion, the most enjoyable activities in basic design education are color-related ones", the mean was *M*=3.41 and the standard deviation *SD*=1.178 (Table 6). With this result, it is seen that the opinions of the students in the first question in this category of the survey were in the direction of the "neutral" option. The students stated that they were neutral about the most entertaining studies in design education those used colors; but as in the other categories, the value in the undecided option seems to have a value very close to the option "agree" (*M*=3.50). This suggests that in design education, students enjoy the design process more when using color.

Regarding the question “In my opinion, the use of color in basic design process contributes to my creativity”, the mean was *M*=3.88 and the standard deviation *SD*=1.120 (Table 6). The opinions of the students in this question were generally in the direction of the option "agree". As a result of these findings, the use of color in the design process contributes to students' creativity.

The question “When I use color in my design, I am able to complete the design process more smoothly”, the mean was *M*=3.44 and the standard deviation *SD*=1.022 (Table 6). The students’ responses were in the direction of ‘neutral’ in this question. The value in this question was similar to the value found in the questionnaire's other neutral options *M*=3.50. Accordingly, color usage in the design process was not always a contributor to the design process. However, color usage might contribute to a smoother and more comfortable design process.

In line with the analysis made in the question “When I use color in my design, I can complete the design process more fluidly/ quickly”, the mean was *M*=3.14 and the standard deviation *SD*=1.180 value (Table 6). The answers of the students were in the direction of "neutral". Compared to the previous question, it is seen that the neutral option in the responses received in this question had a lower value. These data show that the students did not decide that the use of color in the design process contributes to the fluency/fastness of the design process.

Finally, regarding the question “I think creating a color scale/ palette in my design improves the design process”, the mean was *M*=3.98 and the standard deviation *SD*=1.150 (Table 6). The students' opinions were in the direction of "agree". In line with this result, creating the color scale/palette helps the design process and allows the student to pass the design process more comfortably.

This section of the study shows that students selected the option “neutral” in some of the questions. However, it has been noted that the resulting mean was very close to the option *M*=3.50 agree. Accordingly, based on the data obtained from the final part of the survey, some students believe that color studies were more enjoyable than other studies and that color usage improves creativity. It is also believed that color usage did not always affect the smooth/fast transition of the design process, but it sometimes contributed to the smooth transition of the process. The color scale/palette creation in the design process at

the beginning of the process was based on an analysis that helps the design process move more comfortably. As Sherin said, “Color from design elements is one of the most powerful tools a designer has to communicate with” (Sherin, 2012).

In the next section, the analyzed questions were examined as four categories of questions and reviewed for a general discussion.

4.6. GENERAL DISCUSSION

In this section, the answers to the questionnaire questions have been analyzed in groups of questions. The answers to the questions were categorized into Design Process, Color in Problem-Solving Process, Color in Creative Thinking Process, Color Usage in the Design Process. The data obtained from the responses from the students to the five questions under each heading were evaluated, taking the arithmetic average of the mean and standard deviation values of each category and determining each category’s direction according to students’ answers to the questionnaire (Table 7).

Table 7: The values found from the data obtained from the category groups in the survey study.

	Mean(M)	**Std. Deviation (SD)**
Color Decision in Design Process	3.854	0.9988
Color in Problem Solving Process	3.948	1.0044
Color in Creative Thinking Process	3.646	1.0438
Color Usage in Design Process	3.57	1.121

Color Decision in the Design Process: The mean value was found to be *M*=3.854, and standard deviation value was *SD*=0.9988 in the ‘Color Decision in Design Process’ section, which covers the first five questions of the survey (Table 7). These results show a tendency towards the “agree” option as a majority in the students’ responses. In these questions, which were asked to determine the effects of color decisions in the design process, the result obtained from the students' opinions suggests that color decisions

positively contribute to the student in the design process and make the process more efficient. In addition, the results obtained from the questions show that the students, who started to make color decisions at the beginning of the design process, were able to progress the process more easily. These findings show that the formation of color decisions is beneficial for the design process. The formation of color decisions contribute to a more fluent, comfortable and faster design process.

Color in the Problem-Solving Process: In the second part of the survey, the mean had a value of *M*=3.948, and the standard deviation value was *SD*=1.0044 (Table 7). As in the previous section, these data show that there was a tendency towards the direction of "agree". The results show that color contributed positively to the problem-solving process at the beginning of the design process. The results obtained from the questions in this category show that color was an effective tool to emphasize and draw attention to design. At the same time, it suggests that color could be used to produce alternative solutions. Thus, color contributes to the problem-solving process and is one of the essential tools for the design problem.

Color in the Creative Thinking Process: In the third part of the survey, the mean value was *M*=3.646 and the standard deviation value was *SD*=1.0438 (Table 7). As in the other sections, it is seen that there was a tendency towards the option of "agree" from students' answers. The data obtained show that color contributed to the creative thinking process. It also suggests that color contributed to students' creative thinking and helped them produce more original design works. These results suggest that color is an essential factor in developing students' creative process.

Color Usage in the Design Process: In this part of the survey, the mean value was *M*=3.57, and the standard deviation value was *SD*=1.121 (Table 7). Similar to the other two sections, there was a tendency towards the "agree" option in students' answers. This result shows that the use of color contributed to the design process. In other words, the use of color helps students advance the design process more comfortably and fluently and contributes to a more efficient process.

In Basic Design, color, and creativity related studies, Düzenli, Alpak and Özkan (2017, p.1450) state that "the basic design course contributes significantly to the creativity and learning processes of the students". Erim (n.d.) concludes that students' knowledge

levels, perceptions, aesthetic and critical perspectives, creativity and self-confidence are improved. Çubukçu and Dündar (2007) conclude that visual analogy has a positive effect on creativity. Tekel, Tamer, Memlük, Gürer and Kızıltaş (2016) found that students who had interest and experience in visual arts before basic design education had more positive visual perception and expression development processes than students who did not. In addition, it was concluded that visual perception could be improved with basic design education.

This study discusses the design process of students in relation to visual tools 'color' and design education. Studies in the literature reveal that visual tools contribute to creativity and basic design education and the development of creativity in basic design education. This study shows that color contributes to the creative thinking process, problem-solving, and design process. These results suggest that color is an essential tool for design education and is a necessary tool for developing the student's creative thinking ability in design education. The positive results from the questionnaire questions in the previous studies and the positive results from this study are considered evidence of the accuracy of the results achieved in this study.

The correlation test was used to measure the relationship between the questions in the four main groups in the survey. Correlation analysis is a statistical method used to test the relationship between two variables or the relationship of a variable with two or more variables to measure the degree of this relationship. The number of elements is indicated by '*p'*, and the number of elements is indicated by '*n'*, whereas the Correlation coefficient is indicated by '*r*', and it receives values between -1 and +1. The resulting Correlation coefficient is interpreted as follows:

Very weak	Weak	Neutral	High	Very high
r= 0.00-0.25	0.26-0.49	0.50-0.69	0.70-0.89	0.90-1.00

According to the data obtained from Table 8, it was determined that the headings in the entire question group had a meaningful relationship. The highest relationship of meaning was found between 'Color in creative thinking process' and 'Color decision in the design process' (*r*=0.796). It has been concluded that making color decisions with this data contributes positively to students' creative thinking.

Table 8: Correlation test results regarding the relationship between the categories divided into four groups in the questionnaire.

		Color Decisions in Design Process	Color in Problem-Solving Process	Color in creative Thinking process	Color Usage in Design Process
Color Decisions in Design Process	r	1.000	0.579**	0.796**	0.641**
	p	.	0.000	0.000	0.000
	n	64	64	64	64
Color in Problem-Solving Process	r	0.579**	1.000	0.728**	0.587**
	p	0.000	.	0.000	0.000
	n	64	64	64	64
Color in creative Thinking Process	r	0.794**	0.728**	1.000	0.719**
	p	0.000	0.000	.	0.000
	n	64	64	64	64
Color Usage in Design Process	r	0.641**	0.587**	0.729**	1.000
	p	0.000	0.000	0.000	.
	n	64	64	64	64

The Wilcoxon signed-rank test was conducted for the difference between the questions divided into four groups in the survey. The Wilcoxon signed-rank test is a test used to determine whether two interdependent examples show the same distribution.

As seen in Table 9, in line with the results obtained with the statistical analysis, the results were as follows:

- Between Color in the Creative Thinking Process and Color Decisions in the Design Process ($p<0.05$),
- Between Color Usage in the Design Process and Color Decisions in the Design Process ($p<0.05$),

- Between Color in the Creative Thinking Process and Color in the Problem-Solving Process (p<0.05),
- Between Color Usage in the Design Process and Color in the Problem-Solving Process (p<0.05),

While there was a statistically significant difference with the following categories:

- Between Color Decisions in the Design Process and Color in the Problem-Solving Process (p>0.05),
- Between Color Usage in the Design Process and Color in the Creative Thinking Process (p>0.05)

Table 9: Wilcoxon signed-rank test results regarding the differences between the survey categories

	Color Decisions in Design Process and Color in Problem-Solving Process	Color in Creative Thinking process and Color Decisions in Design Process	Color Usage in Design Process and Color Decisions in Design Process	Color in Creative Thinking process and Color in Problem-Solving Process	Color Usage in Design Process and Color in Problem-Solving Process	Color Usage in Design Process and Color in Creative Thinking process
z	-1.405b	-3.264c	-3.164c	-4.355c	-4.143c	-.918c
p	0.160	0.001	0.002	0.000	0.000	0.359

Results show that color decisions contribute to creative thinking (p=0.001), and color usage contributes to problem-solving (p=0.000). According to these test results, color decisions can be said to improve creative thinking, help students in the problem-solving process of color use to solve the design problem and have a positive interaction between color usage and color decisions. However, according to the Wilcoxon signed-rank test results, there was no significant difference between problem-solving and color decisions (p=0.160), neither between color usage and creative thinking (p=0.359). These results show that color decisions were not related to the problem-solving process. Furthermore, color usage were not associated with the creative thinking process.

5. CONCLUSION

Basic design education, which is given in the first year of studio education in Interior Architecture education and all design disciplines in general, is essential for students' other studio education skills and professional life. The purpose of basic design education is to teach the students' design principles and elements. Additionally, it aims to use them in a design sense, gain design skills, develop their creative abilities, approach the given design problem in a versatile way, and produce a solution to the design problem.

Visual tools are essential for design education. Individuals who are not trained in design education are expected to be introduced to design elements within the scope of this course. In general, basic design course aims to provide individuals with the ability to design using design elements and principles. Color as a design element included in design education is an essential tool for design education. The target point of this work was 'color', one of the design elements.

Throughout this study, the effect of color was investigated on the basis of its value in design education and its relationship with the principles of visual composition. Furthermore, its effect on the creative thinking process, on the problem-solving process, and its effect on the design process were examined. The research was carried out in the basic design course, known as the basis of design methods. Basic design students of Çankaya University, Interior Architecture, were the participants of this study during the 2nd Semester of the Introduction to Interior Design course (INAR 102). The fact that the students had done color-related studies before this course and had undergone a design process in color-related studies made us think that they would answer the questions with more ideas. For this reason, it is believed that the accuracy of the answers obtained from the questions increases.

To answer the question “What is the effect of color on the design process?”, the sub-headings in the survey study were as follows:

- Color Decisions in the Design Process
- Color in the Problem-Solving Process
- Color in the Creative Thinking Process
- Color Usage in the Design Process

A total of 64 students participated in the survey, which was prepared based on a 5-point Likert scale, and all of the participating students answered the questions without leaving any blanks. The Mean and Standard Deviation Statistics was used to evaluate the results of the survey study. This technique analyzed in which the tendencies to the responses from the students. The findings revealed that students' responses were generally in the direction of "agree".

In line with the findings, it was concluded that color positively contributes to the design process. Furthermore, it has been concluded that the use of colors positively affects the design process and contributes to a more comfortable, fluent, and efficient process. In addition, it was concluded that color contributed positively to the creative thinking process. With this result, it is concluded that the use of colors helps the development of students' creative thinking abilities. In this direction, it can be said that color is one of the critical tools for students to make original design artefacts. Additionally, it was concluded that color also contributed to the problem-solving process. This result shows that the color element is one of the tools that help students in the problem-solving process. The last part of the survey study has been determined in line with the analysis that the use of color positively affects the design process.

The obtained results show that color is an essential element for design education and should be included in design education. This research was carried out with the thought that it would be beneficial for students' attitudes towards the use of color in their designs and for their future projects. In addition, when the previous studies in the literature were examined, it was noteworthy that there was no study on the design process and the effect of color. It is believed that this study will fill the literature gap and help future studies on color and design education.

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INTERNET RESOURCES

https://www.pinterest.es/pin/329677635203133116/

http://www.coskuncanli.com/renk-teorisi/

https://www.cyberphysics.co.uk/topics/light/colorAddition.html

https://www-dsource-in.translate.goog/course/visual-design-colour-theory/colour-design-principles?_x_tr_sl=auto&_x_tr_tl=tr&_x_tr_hl=tr&_x_tr_pto=ajax,se

https://www.https://bilgipaketi.cankaya.edu.tr/

APPENDIX A SURVEY WORK

Rengin Tasarım Sürecine Etkisi Anketi / Influence of Colour on Design Process Questionnaire

Çankaya Üniversitesi, Fen Bilimleri Enstitüsü, İç Mimarlık Ana Bilim Dalı'nda yürütülen bu araştırma, Dr. Öğr. Üyesi Saadet AKBAY YENİGÜL ve Öğr. Gör. Dr. Gökçe ATAKAN danışmanlığında, Yüksek Lisans öğrencisi Buse Berivan ŞİMŞEK'in tez çalışmasının bir gereği olarak yapılmaktadır.

Bu çalışma, temel tasarım eğitiminde rengin tasarım sürecine olan etkisini araştırmak amacı ile kurgulanmıştır. Söz konusu çalışma, Çankaya Üniversitesi INAR 102 İç Mimarlığa Giriş birinci sınıf stüdyo dersi kapsamında yapılacaktır. Bu araştırma kapsamında toplanan veriler, sadece bilimsel amaçlar doğrultusunda kullanılacaktır. Uygulanan test ve envanterlerin sonuçları, katılımcıların ders performansını ve/veya notlarını kesinlikle etkilemeyecektir. Katılımcıların kimlik bilgileri gizli tutulacaktır.

Sizden istenen, size sunulan sorulara samimi ve öznel cevaplar vermenizdir. Gönüllü katılım formunu okumak ve değerlendirmek üzere ayırdığınız zaman için teşekkür ederim.

This research is to be carried out in Çankaya University, Institute of Applied Science, Interior Architecture Department, under the consultancy of Assist. Prof. Dr. Saadet AKBAY YENİGÜL and Instr. Dr. Gökçe ATAKAN, as a requirement of the master's degree thesis studies of the graduate student Buse Berivan ŞİMŞEK. This study aims to evaluate the influence of colour in design process through basic design education. This study is to be carried out within the studio course of INAR 102 Introduction to Interior Design, which corresponds to the first-year curriculum of the Department of Interior Architecture, Çankaya University. The data collected within the scope of this research will be used for scientific purposes only. The questionnaire findings will not affect the

course performance and/or grades of the participants. Participants' identity information will be confidential.

You are asked to give sincere and subjective answers to the given questions. Thank you for taking the time to read and evaluate the volunteer participation form.

Buse Berivan ŞiMŞEK

Katılımcının Beyanı/ *Participant's Statement*

Dr. Öğr. Üyesi Saadet AKBAY YENİGÜL, Öğr. Gör. Dr. Gökçe ATAKAN ve Yüksek Lisans Öğrencisi Buse Berivan ŞİMŞEK tarafından, Çankaya Üniversitesi, Fen Bilimleri Enstitüsü, İç Mimarlık Ana Bilim Dalı'nda yürütülmekte olan araştırma ile ilgili bilgiler tarafıma detaylı bir şekilde aktarıldı.

"Araştırmanın tarafımca katılım sağlanmış kısmındaki, tarafıma ait değerlendirmelerin araştırma ve eğitim amaçlı olarak kullanılabileceğini biliyor ve bunu onaylıyorum. Bu konuda yapılan daveti memnuniyet ve gönüllülük içinde kabul ediyorum".

I was informed by Assist. Prof. Dr. Saadet AKBAY YENİGÜL, Instr. Dr. Gökçe ATAKAN, and the graduate student Buse Berivan ŞİMŞEK about the research conducted at the Department of Interior Architecture, Graduate School of Natural and Applied Sciences, Çankaya University.

"I recognize that the contribution provided by my side to this study might be used as a set of data for scientific research and educational purposes, and I approve the evaluation and utilization of this data. I accept the invitation on this subject with consent and willingness."

Tarih/ Date: ..... / .... / 2021

Öğrenci Numaranız/ Student ID:

☐ **Onaylıyorum/ Approve**

Demografik Sorular

1. Yaşınız/ *Age*

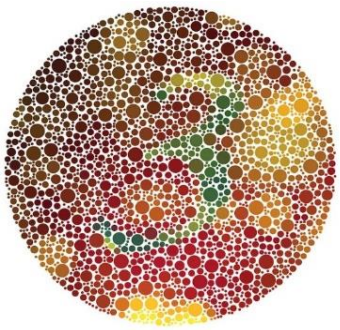
2. Cinsiyetiniz/ *Gender*

3. Görme bozukluğunuz var mıdır? (astigmat, miyop, göz tansiyonu, katarakt vb. gibi). Lütfen belirtiniz.
Do you have any vision impairments? (such as astigmatism, myopia, eye pressure, cataracts, etc.). Please specify.
Var/ *Yes*
Yok/ *No*

4. Görme bozukluğunuzu düzeltecek bir araç kullanıyor musunuz?
Do you use an apparatus to correct your vision impairment?
Evet (lens, gözlük vb. gibi). Lütfen belirtiniz. / *Yes (such as lenses, glasses, etc.). Please specify.*
Hayır/ *No*
Görme bozukluğum yok/ *I have no visual impairment.*

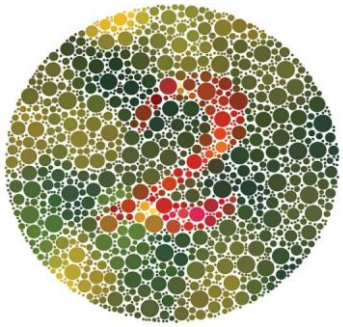
5. Renk görme bozukluğunuz var mıdır? / *Do you have colour vision deficiency?*
Evet/ *Yes*
Hayır/ *No*

6. Dairenin içinde ne görüyorsunuz? / *What do you see inside the circle?*



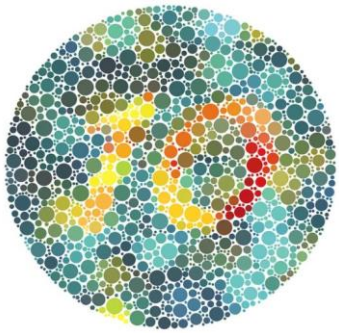
- *Lütfen belirtiniz/ Please specify*

7. Dairenin içinde ne görüyorsunuz? / *What do you see inside the circle?*



- *Lütfen belirtiniz/ Please specify*

8. Dairenin içinde ne görüyorsunuz? / *What do you see inside the circle?*



- *Lütfen belirtiniz/ Please specify*

9. Çankaya Üniversitesi İç Mimarlık Bölümü'nde eğitime başlamadan önce renkle ilgili bir uğraşınız ya da aldığınız bir eğitim oldu mu? (resim kursu, renk çalışmaları, önceden okuduğunuz önlisans/ lisans eğitimi kapsamında vb.). / *Before your current education in Çankaya University, Department of Interior Architecture, did you have any avocation and/or activity related to colour? (painting course, colour studies, within the scope of your earlier associate/ undergraduate education, etc.).*

Evet (Lütfen uğraşınızı ya da aldığınız eğitimin kapsamını kısaca süresi ile birlikte açıklayınız). / *Yes (Please briefly describe the avocation you took part in and the scope of the training you received, including its duration.*

Hayır/ *No*

General

10. Tasarım yaparken, tasarım sürecini yüzde (%) olarak değerlendirecek olursanız, renk bu sürecin ne kadarını kapsar. / *If you consider the design process as a whole what would be the percentage of colour in this process.*

- %30'dan az/ *less than 30%*
- %30 - %50 arası/ *between 30 %to 50 %*
- %50/ *50%*
- %50 - %70 arası/ *between 50% to 70%*
- %70'den fazla/ *more than 70 %*

Aşağıdaki sorular 1'den 5'e kadar likert ölçeği ile hazırlanmıştır. Lütfen aşağıdaki soruları 1 ile 5 arasında değerlendirerek size gelen en uygun seçeneği işaretleyiniz/ *The following questions were prepared on a likert scale from 1 to 5. Please rate the following questions on a scale of 1 to 5 and tick the most appropriate option.*

Likert Ölçeği 1'den 5' kadar/ *Likert Scale From 1 to 5*

1. Kesinlikle katılmıyorum/strongly disagree
2. Katılmıyorum/disagree,
3. Kararsızım/Neutral,
4. Katılıyorum/ agree,
5. Kesinlikle katılıyorum/ strongly agree

Colour Decision in Design Process	**1**	**2**	**3**	**4**	**5**
1. Tasarıma dair renk kararlarım oluşmaya başladığı zaman çalışmamın daha kolay ilerlediğini düşünüyorum. / *In my opinion, my work progresses more easily when my colour decisions become clearer in design.*					
2. Tasarıma renk ile düşünerek başladığım zaman, bu süreçte daha keyifli vakit geçiriyorum. / *When I start designing by contemplating about colour, I have a more enjoyable time during the process.*					
3.Tasarım sürecinde çalışmamı renk ile düşündüğüm zaman projeme yeni anlamlar/kavramlar ekleyebiliyorum. / *When I think about my work including colour during the design process, I can add new meanings/concepts to my project.*					
4. Farklı renk kararlarımın tasarımım ile ilgili alternatif çözümler üreteceğini düşünüyorum. / *In my opinion, my decisions on various colours might produce alternative solutions for my design.*					
5. Tasarım sürecinde renk kararlarımı sevdiğim renkler üzerinden kurguluyorum. / *During the design process, I construct my colour decisions upon the colours I like.*					

Colour in Problem-Solving Process	**1**	**2**	**3**	**4**	**5**
6. Tasarımımda renk kullanarak bir probleme karşı birkaç çözüm üretebiliyorum. / *I can produce several solutions to a problem using colour in my design.*					
7. Tasarım sürecinde, tasarımımla ilgili çıkmaza girersem renk kararlarımı değiştirerek, yeni/alternatif çözümler üretebiliyorum. / *During the design process, if my design process gets to a halt, I can change my colour decisions and create new/alternative solutions.*					
8. Tasarım probleminin çözümünde yapmak istediğim vurguyu renk ile yapabileceğimi biliyorum. / *I know that I can make the emphasis I want to make in solving the design problems with colour.*					
9. Tasarımımda renk farklılıkları ile ayrıntılara dikkat çektiğimi düşünüyorum. / *In my opinion, I draw attention to details with colour differences in my design.*					
10. Aynı malzemeyi başka renk ile kullanarak elimdeki malzemenin kullanım şeklini çoğaltabileceğimi düşünüyorum. / *In my opinion, I can improve the usage of the material by using the same material with different colours.*					

Colour in Creative Thinking Process	**1**	**2**	**3**	**4**	**5**
11. Tasarımımdaki renk kararlarım ile diğer stüdyo arkadaşlarımdan daha yaratıcı bir ürün/çalışma ortaya koyduğumu düşünüyorum. / *In my opinion, I can produce a more creative product/work than my studio peers with colour decisions in my design.*					
12. Tasarım sürecinde bana rengin diğer tasarım elemanlarına göre daha çok ilham verdiğini düşünüyorum. / *In my opinion, colour inspires me more than other design elements in the design process.*					
13. Aynı malzemeyi, başka renkler ile kullandığım zaman yeni bir malzemeye ihtiyacım olmadan tasarımımı ilerletebileceğimi düşünüyorum. / *In my opinion, when I use the same material with other colours, I can advance my design without the need for a new material.*					
14. Tasarım sürecinde rengin çok yönlü düşünebilmemi sağladığına inanıyorum. / *I believe that colour enables me to think in a versatile way in the design process.*					
15. Tasarım sürecinde rengin yaratıcı tasarımlar ortaya çıkarmamda yardımcı olduğunu düşünüyorum. / *In my opinion, colour guides me to produce creative designs in the design process.*					

Colour Usage in Design	**1**	**2**	**3**	**4**	**5**
16. Temel tasarım eğitiminde en eğlenceli çalışmaların renk ile yapılanlar olduğunu düşünüyorum. / *In my opinion, the*					
17. Temel tasarım sürecinde renk kullanımının yaratıcılığımı geliştirmeye katkı sağladığını düşünüyorum. / *In my opinion, the use of colour in basic design process contributes to my creativity.*					
18. Tasarımımda renk kullandığım zaman tasarım sürecini daha sorunsuz bir şekilde tamamlayabiliyorum. / *When I use colour in my design, I am able to complete the design process more smoothly.*					
19. Tasarımımda renk kullandığım zaman tasarım sürecini daha akıcı/hızlı bir şekilde tamamlayabiliyorum. / *When I use colour in my design, I can complete the design process more fluidly/quickly.*					
20. Tasarımımda renk skalasını/paletini oluşturmanın tasarım sürecine yardımcı olduğunu düşünüyorum. / *I think creating a colour scale/palette in my design, improves the design process.*					

APPENDIX B TEST OF NORMALITY

Table 10: Normality Test Results of Twenty Questions in the Questionnaire.

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Color Decision in Design Process						
1. question	0.260	64	0.000	0.856	64	0.000
2. question	0.200	64	0.000	0.881	64	0.000
3. question	0.253	64	0.000	0.795	64	0.000
4. question	0.232	64	0.000	0.823	64	0.000
5. question	0.207	64	0.000	0.878	64	0.000
Color in Problem Solving Process						
1. question	0.215	64	0.000	0.882	64	0.000
2. question	0.177	64	0.000	0.902	64	0.000
3. question	0.259	64	0.000	0.789	64	0.000
4. question	0.341	64	0.000	0.700	64	0.000
5. question	0.276	64	0.000	0.804	64	0.000
Color in Creative Thinking Process						
1. question	0.213	64	0.000	0.893	64	0.000
2. question	0.174	64	0.000	0.903	64	0.000
3. question	0.185	64	0.000	0.908	64	0.000
4. question	0.268	64	0.000	0.832	64	0.000
5. question	0.223	64	0.000	0.829	64	0.000
Color Usage in Design Process						
1. question	0.166	64	0.000	0.904	64	0.000
2. question	0.217	64	0.000	0.842	64	0.000
3. question	0.209	64	0.000	0.900	64	0.000
4. question	0.203	64	0.000	0.905	64	0.000
5. question	0.227	64	0.000	0.817	64	0.000