SUNLIGHT IN PRESCHOOL LEARNING ENVIRONMENTS

İKLİME POLAT YALÇINER

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Approval of the Graduate School of Social Sciences

Assoc. Prof. Dr. Mehmet Efe Biresselioğlu

Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Design.

Prof. Dr. Murat Bengisu

Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Design.

Assoc. Prof. Dr. Deniz Hasırcı

Supervisor

Examining Committee Members

Assoc. Prof. Dr. Deniz Hasırcı

Assoc. Prof. Dr. Sezin Tanrıöver

Asst. Prof. Dr. Altuğ Kasalı

ABSTRACT

SUNLIGHT IN PRESCHOOL LEARNING ENVIRONMENTS

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This study analyzes the role of sunlight in preschool children's focus and intends to make a contribution to the improvement of the preschool learning environments. Sunlight is a source of energy for all people who spend most of their time indoors. Children spend up to 40 hours a week in educational settings mostly under artificial lighting whereas they need to be exposed to more sunlit environments as sunlight has numerous positive effects on children and children's spaces. These include positive contributions to attitudes and performance (Samani and Samani, 2012) as well as academic test scores (Tanner, 2009). It has also been found that sunlight may have positive effects on focus and concentration (Taylor and Kuo, 2011). In order to analyze the role of sunlight on preschool children, in this study, children from a private preschool were asked to choose one from three classroom settings with different lighting scenes prepared with SketchUp+Vray version 2017. Additionally, children were surveyed about their classroom's scale model about their preferences of different size window options and desired sunlight levels. Lastly, children's teachers answered a questionnaire about the relationship between sunlight and learning environments. The results indicate that sunlight may affect children in a positive way and interior architecture contributes to learning environments in that sense.

Keywords: Preschool children, Sunlight, Learning environments, Concentration, Interior architecture

ÖZET
OKUL ÖNCESİ EĞİTİM MEKANLARINDA GÜNEŞIŞIĞI

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Bu çalışma, güneş ışığının okul öncesi çocukların odaklanması üzerindeki rolünü analiz eder ve okul öncesi öğrenme mekanlarının iyileştirilmesine katkıda bulunmayı hedefler. Güneş ışığı, zamanının çoğunu iç mekanlarda geçiren tüm insanlar için bir enerji kaynağıdır. Çocuklar haftada 40 saat kadar zamanlarını eğitim mekanlarında ve genellikle yapay ışık altında geçirmektedirler. Bununla birlikte, güneş ışığı çocuklar ve çocuk mekanları üzerinde çok sayıda olumlu etkiye sahiptir. Bunlar, çocukların tutum ve performanslarına olumlu katkıları (Heschong ve Mahone, 1999; Samani ve Samani, 2012) ve akademik test puanlarına olan katkılarıdır (Tanner, 2009). Güneş ışığının odaklanma ve konsantrasyon üzerinde olumlu etkileri olabileceği de bulunmuştur (Taylor ve Kuo, 2011). Bu çalışmada, güneş ışığının okul öncesi çocukların odaklanması üzerindeki rolünü analiz etmek için özel bir okul öncesi kurumundaki çocuklara SketchUp+Vray versiyon 2017 programı ile hazırlanmış üç boyutlu sınıfın üç farklı aydınlatma sahnelerinden birini tercih etmeleri istendi. Ayrıca çocuklar sınıflarının ölçekli maketi üzerinden farklı boyutlardaki pencere tercihlerini ve sınıflarında olmasını istedikleri güneş ışığı seviyelerini sebepleriyle birlikte açıkladılar. Son olarak, çocukların öğretmenleri, güneş ışığı ve eğitim mekanları arasındaki ilişki hakkında bir anket yanıtladılar. Sonuçlar, güneş ışığının çocukları olumlu yönde etkileyebileceğini ve iç mimarinin bu anlamda eğitim mekanlarına katkıda bulunduğunu göstermektedir.

Anahtar Kelimeler: Okul öncesi yaştaki çocuklar, Güneş ışığı, Eğitim mekanları, Konsantrasyon, İçmimarlık

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CHAPTER 1

INTRODUCTION

This thesis analyzes the role of the sunlight on preschool children's learning environments and intends to make a contribution to the improvement of the preschool learning environments.

1.1. Scope of the Thesis

Sunlight is a source of energy for all people who spend most of their time indoors. Children spend up to 40 hours a week in educational settings mostly under artificial lighting. However, sunlight has numerous positive effects on children and space. These include positive contributions to attitudes and performance (Heschong and Mahone, 1999; Samani and Samani, 2012) and their contribution to academic test scores (Tanner, 2009). It has also been found that sunlight has positive effects on focus and concentration (Taylor and Kuo, 2011). The purpose of this study is to evaluate the role of the sunlight on preschool children's focus and to make suggestions for interior design proposal and contribute to the improvement of the preschool learning environments.

1.2. Attention and Concentration

The first step of the learning cycle is attention that includes processes like filtering out perceptions, balancing multiple perceptions and attaching emotional significance as well as noticing incoming stimuli (Ratey, 2001).

Neurological description of attention is defined as diffuse patterns of activation among distinct cortices during the performance of actual and imagined sensorimotor tasks. Attention narrows when cognitive load increases. The limits of cognition are related with the attention which adds a directional component to behavior,

modulating responses to the environment by focusing the mind on specific objects, locations, especially when the cognitive load is higher (Oakley, 2004).

Attention is a body function and usually shifts very quickly between objects and things. When a person focuses his attention on any length of time, it is referred as concentration. Thus paying attention is the body function that makes the skill of concentration possible (Edublox Reading and Learning Clinic, 2017).

Gaddes (1994) defines two basic forms of attention as passive and active attention. Passive attention is automatic and directed by external stimulants while active attention is optional and guided by alertness, concentration, interest, and needs such as curiosity. Thorne and Thomas (2009) states that, active attention is the bidirecional cognitive process that includes the ability to consistently maintain the mental effort while fulfilling the duties that requires mental energy and the ability to focus on a specific and important task.

Sohlberg and Mateer (1989) explained attention process as divided into five components such as focused attention, sustained attention, and selective attention, alternating attention, and divided attention. On the other hand, Oakley (2004) states the three components of attention as selection, sustain, and control. Selective attention takes an item from the ambience or from the long-term memory and associates it with the information from working memory while sustained attention takes a specific information from the sensory store and working memory to link it with conceptual and cultural diagrams of the long-term memory store.

According to Posner and Boies' attention model (1971), human attention can be divided into three components as alertness, selectivity, and processing capacity. The capacity to choose one source rather than other is provided by selectivity (Egeth, 1967). Mirsky's attention model (Mirsky et al., 1991) identified four factors of attention as shift, sustain, encode, and focus. Shift factor is most predictive of affect perception scores. Second, the ability to sustain attention over time may be important because people must constantly follow social dialogue to detect changes in emotional states. A person who constantly looks away and does not stay focused on the conversation at hand is more likely to miss important social and emotional cues.

This first chapter explains the scope of the study as evaluating the role of the sunlight on preschool children's focus and preschool learning environments. Thus, this chapter summarizes the meaning, forms, and process of attention.

CHAPTER 2

SUNLIGHT AS A FEATURE OF BIOPHILIA, AND CHILDREN

Rogers defined biophilia as human attraction to nature (2010). Ulrich (1999) studied the healing power of nature in the clinical context using evidence-based design. Biophilic design research arises from Ulrich's (1984) study which shows being exposed to a view of nature helps the recovery of patients after surgery. The results show seeing views of trees and plants has restorative influences on patients' mental health. Ulrich's findings helped to support a design approach that could take advantage of biophilic elements like sunlight, plants, trees, or even docile animals which help reduce stress and anxiety.

Kellert and Wilson (1984: 416) explained the term biophilia to be inclined to establish relationships with nature. Louv (2008: 43) explains the term as an existentially attachment to nature as a result of biologically based need. Louv defends interaction with nature is necessary for early childhood because staying away from nature causes nature-deficit disorder.

Bates (2010) states that being in a space with a natural element such as a waterfall painting or houseplant is passive or indirect contact with nature but still that interaction meets the need for being in contact with nature. Sitting in the sunlight that is streaming into the interior can be defined as a direct interaction with nature. Sunlight exposure has been linked to controlling the body's circadian rhythms, job satisfaction, and aids diverse healthcare outcomes (Joseph, 2006).

McGee (2012), states that exposure to natural conditions is related to child development. Moreover, White (2015), expresses the contributions of nature to the children's cognitive development. Kellert (2005), investigates the physical mental

development of children and finds out that experience to be in the nature help children's development as regards to social, psychological academic and physical context.

2.1. Biophilic Design

Clark and Chatto (2014), defined biophilia as a desire to be connected to nature while and expressing biophilic design to be a possible solution for children's well-being and learning.

Kellert (2008) proposed a categorization of more than 70 biophilic design attributes within six biophilic elements in order to assist designers and developers to practically apply biophilic design in the built environment. These elements are environmental features such as sunlight or plants; natural shapes, and forms; natural patterns and processes; light and space which focus on qualities of light or spatial harmony; place-based relationships; and evolved human-nature relationships that focuses on fundamental aspects of the inherent human relationship to nature.

The study of Barrett et al. (2015) gives assessments from 3766 pupils from 153 classrooms and the results show that physical features of classrooms effect children's learning and academic development. Thus, seven key design parameters to provide an effective learning space are defined as light, temperature, air quality, ownership, flexibility, complexity, and color.

Greenwood and Gatersleben (2016) state that for most people with various backgrounds and cultures, or amongst adults and children, nature's effect has been restorative and beneficial to psychological well-being by reducing stress, improving mood and concentration. 120 adolescents aged between 16 to 18-year-olds in the UK are experienced restoration of stress and mental fatigue in an outdoor or indoor environment, alone, with a friend or while playing a game on a mobile phone. Results showed that adolescents who had been in an outdoor setting with natural elements have greater restoration when compared with those who had been in an indoor one. Spending time with a friend increased positive effect in nature for this age group. The findings show that spending short school breaks in a natural environment with a friend can have a significant positive impact on the

psychological well-being of teenagers. All in all, environments even just containing natural elements can restore attention fatigue effectively.

2.2. Sunlight

Heschong and Mahone (1999), examines the effects of sunlight on human performance with regards to being able to focus on a task. The results of the study show that students with the most sunlight and largest window in their classrooms progressed faster on two separate math and reading tests than those with the least. As a result, skylights that benefit from sunlight have a positive effect on student performance.

According to Healthy Schools Network report (2005;2012), children's health and learning abilities are affected by poor or inappropriate lighting in the schools. Sunlight is a necessary source for the energy of all human beings who spend over 90% of their time indoors. Children spend most of their time in school buildings and at that time they are exposed to artificial lighting. A two-year study of six schools in Johnston County, North Carolina compared lighting conditions. The result shows that children are healthier and more positive when they are exposed to full-spectrum lighting. Reported results of the research clarifies that natural lighting had a positive effect on students' attitudes and performance such as lowering hyperactivity symptoms (Healthy Schools Network, 2005 and 2012).

Samani and Samani (2012) states that, the illumination of learning spaces plays a critical role as there is an important link between good lighting and students performance as regards to learning skill, mental manner, and performance. A well-lit classroom includes glare control, balanced brightness, and higher reflectance ratings. As a result, good lighting is to supply appropriate illuminance, creating a successful living, working and learning environment, and is necessary to ensure safety, as well as, well-being, health and QoL (Samani and Samani, 2012).

2.3. Green Environments

Green environments are important for both mental health and regular engagement with longevity and decreased risk of mental ill-health. A study shows that green exercise leads to positive short and long-term health outcomes. 1252 participants

involved in that study with research of meta-analysis methodology. Results confirm that green environments improve both self-esteem and mood (Barton and Pretty, 2010).

Environments affect children and their skills and their positive behaviors. (Cohen et al, 1973). Thus, settings that are responsive and more flexible may support cognitive development of children (Wachs and Gruen, 1982).

Indoor habits contribute to childhood chronic conditions like obesity, asthma, isolation, childhood depression, vitamin D deficiency, as well as ADHD. Children's lack of physical activity and their growing disconnection with the natural environment have been influenced by technology and environmental barriers. Outdoor activity in natural environments may have the potential to improve children's mental health and physical well-being (McCurdy et al., 2010).

People want acceptance in social life in order to satisfy their belonging need, but ostracism which means being ignored can preclude this need. Poon et al. (2016) state that, nature exposure can weaken the relationship between ostracism and aggression. According to the biophilia hypothesis (Kellert and Wilson, 1995), human beings have a strong instinctual bond to nature. It is not strictly necessary to be in an actual natural environment, just seeing natural stimuli like viewing photos or videos of landscapes can also lead to many positive consequences such as positive mood, increased memory and attention capacity, and subjective well-being.
There is a connection between access to nature and concentration. Among children, the benefits are being creative and more imaginative in natural environments as well as physical agility and social confidence. Additionally, a recent research in Sweden even shows that natural environments provide children to play together and exterminate gender-based differences (Chawla, 2012).

Harvard Mahoney Neuroscience Institute (2010) expresses that, simply spending a few minutes on a busy city street can affect the brain's ability to focus In this study, one group of participants spent time in a park and the other group was on a busy city street and psychological tests results show that the group in the city street scored significantly lower on attention and working-memory tests compared to the participants spending time in the park. The reason why attention is lower in group

who walked in busy city street is because there is too much distractions for attention like traffic, neon lights or sirens.

Patients staying in hospital rooms that with a view of nature recover quicker than patients without an arboreal view (Ulrich, 1984). This situation may be the result of a concept restoration theory developed by environmental psychologists Kaplan and Kaplan (1989) who state that people can concentrate better after spending time in nature or even after simply looking at pictures of nature.

2.4. Activities

Barker (2014) et al. hypothesized that children who spend more time with less-structured activities would have a chance to practice self-directed executive functioning which predicts important outcomes such as academic performance, health, wealth and criminality. 70 six-year-old children were individually tested in a single session lasting approximately 1.5h, with breaks given as needed. Also, parents have recorded their children's daily activities for a week. The activities categorized activities as either more structured or less structured. All child-initiated activities (play, spontaneous practice, and reading, watching television) and outings and events (museum or library visits, sporting events) were coded as "Less-Structured." Adult-led lessons and practices, homework and studying, religious activities, and organization meetings (e.g., community service) were coded as "Structured." The study found that children who participate in more structured activities had a poorer self-directed executive function which is a measure of the ability to set and reach goals independently. In that classification system, less-structured activities include free play alone and with others, social outings, sightseeing, reading and media time.

Louv (2008: 36) coined the term, "nature deficit disorder" to describe children's lack of outdoor activity and the experience of unstructured free play in the outdoors. Louv states that children's experience of nature mostly occurs indoors such as looking out of the car's window, watching nature on monitors that means they are in indirect experience with nature through electronics and machinery. As a result, Louv proposes the results of nature deficit disorder as diminished use of the senses, attention deficit disorder, and higher rates of physical and emotional illnesses childhood obesity, impaired social skills. Louv (2008) stated that direct exposure to

nature is essential in order to increase a child's powers of concentration and shape creativity. Creativity is even related to childhood experiences in nature.

Environment-based education improves standardized test scores and grade point averages and develops skills in problem-solving, critical thinking, and decision making. According to the American Academy of Pediatrics (2007), free play allows children to use their creativity and imagination while protects against the effects of pressure and stress. Unstructured play is also important for healthy brain development; children learn how to work in groups, share, negotiate, resolve conflicts, and learn self-advocacy skills as well as practice decision-making skills (Ginsburg, 2007).

Children's experience of nature increases awareness and social responsibility leads them to more physical activity, enhance learning and problem-solving skills, and prepares students for the challenges and opportunities. Children who spend time outdoors are physically more active (Cleland et al., 2008). The American Academy of Pediatrics states that (2007), being in contact with nature and doing outside activities develop children's physical, intellectual, emotional, social and cognitive development as it increases levels of physical activity, reduces stress and serves as a coping mechanism for children with ADHD.

Gabriela and Dias (2017) explain that, the use of natural elements in children's play creates a more sustainable strategy and contributes children's education. For example, playing with soil and water can help children to learn about mathematics, science or language. As children filled and emptied containers, several times, they could explore notions related to weight, volume and time. Thus, playing with natural elements outside provides exposition to sunlight, and opens air that contributes to bones development, stronger immune system, and physical activity.

Nature can become a teaching tool that helps children engage with the environment and allows them to gain a greater understanding of the world. Environmental education provides children learning and problem-solving skills and prepares them for the challenges as well as improving academic performance, self-esteem, personal responsibility. Thus, after-school programs should be arranged to use the outdoors for physical activity and dynamic learning (Davy, 2009).

One study shows that there is an association between physical activities in a classroom, including physical education, and academic performance, including indicators of cognitive skills and attitudes, academic behaviors, and academic achievement. For this review, relevant research articles and reports were investigated and and the literature review is categorized according to outcomes. These outcomes are academic achievements such as grades, academic behavior such as on-task behavior, cognitive skills, and attitudes such as attention, concentration, memory, and mood. As a result, there were associations between physical activity and academic performance, achievement, behavior, and cognitive skills and attitudes. The studies explored that short physical activity breaks between 5–20 minutes promote learning and affect cognitive skills of children (Centers for Disease Control and Prevention, 2010).

2.5. Health and Well-being

McGee (2012), states that natural conditions are related to child development while Kellert (2005) investigates physical and mental well-being for children's emotional intellectual and evaluative developments. Children's health is positively affected by nature in different ways such as being creative, problem solving, having developed cognitive abilities, and reducing symptoms of ADHD and stress.

Clark and Chatto (2014), explains this development by giving an example of design solutions connected to nature as regards to biophilia as a central design strategy and affect individuals' well-being. Tezuka (2014) states that leaving children free in a learning environment is important for their individual developments. Thus, he supports his statement with giving example of Fuji Kindergarten which is designed by Tezuka Architects as a ring under the trees with a natural circulation and points out the positive effects of nature on children's psychology and educational development.

2.5.1. Body Health

Cheng and Monroe (2012) express that connection to nature increases children's psychological well-being and also is linked with variables that foster positive affective attitudes, such as family values, previous experiences in nature, and

knowledge of the environment. Additionally, children who spend more time nearby nature cope better with life stress than others.

Natural environments relieve stress and have a restorative effect on people as there is nature guiding human behavior. Kaplan and Kaplan (1989) analyzed the role of nature in psychology and physical health of children and expressed that natural contact can increase the concentration of the children.

Obasanjo (1998) found that poor housing quality causes poor cognitive control and high levels of directed attention fatigue among youth between ages 15-19. This suggests that housing quality may have critical effects on younger children. The environment can make a difference in the psychological and cognitive well-being of children.

2.5.2. Psychological Health

White (2004), investigates the natural environment's positive effects on children's psychological well-being. The article explains that being in contact with natural environments provides children with lots of advantages and positive effects on their psychological well-being, superior cognitive functioning, fewer physical ailments, and enables speedier recovery from illness.

Moreover, Moore and Wong (1997), analyze designing natural learning spaces that affect children's positive behavior by the help of teaching the basics in outdoor settings and offering ideas on creating areas engaged with nature.

Research shows that ADHD is one of the most common preschool childhood psychiatric disorders listed before oppositional defiant and conduct disorders, anxiety disorders, and depressive disorders (Egger and Angold, 2006). The National Institute of Mental Health (NIMH) (2016) defines ADHD as a brain disorder marked by an ongoing pattern of inattention and or hyperactivity/impulsivity that interferes with functioning or development. Robaey et al. (2015) state that, ADHD is a complex interplay of genetic and environmental risk factors characterized by inattention, hyperactivity, and impulsivity. NIMH explains inattention as, “a person's being weak in paying attention, being easily distracted, and forgetful” (NIMH, 2016). Hyperactivity refers to excessive motor activity and a person's constant movement in

every situation, even if it is inappropriate. Impulsivity is a person with hasty actions occurring at the moment without thinking and having impulsive tendencies (ADHD Institute, 2016).

ADHD is often first recognized in childhood and it affects a child's cognitive, academic, behavioral, emotional, and social functioning, and the condition often continues into adulthood. The disorder is called "attention deficit and hyperactivity disorder" in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) diagnostic criteria. Just attention deficit or only hyperactivity disorder symptoms can be seen in a person or one can have both. Even if the person just has one of the symptoms, the diagnosis is ADHD (Şahin, 2013). According to DSM-V Diagnostic Criteria, ADHD is three types such as combined type, predominantly inattentive type and predominantly hyperactive-impulsive type.

There are studies about the case but generally on the basis of statistics, symptoms or healing but not related to light, natural learning spaces or concentration. One study shows systematic review of QoL studies in children and young people with ADHD and addresses questions like the impact of ADHD on QoL (Yurteri N, Akay A., 2014). Es et al., 2011) investigate the effects of combined treatment on children with disruptive behavior disorders and found out that combined treatment was effective in reducing the ADHD. Öş et al. (2010) compare the QoL measures obtained from newly diagnosed subjects with ADHD and healthy controls. The results showed that ADHD had a negative effect on almost all areas of functioning.

Taylor and Kuo's (2011) study examines whether routine exposures to greenspace might help to reduce the symptoms of ADHD and proposes that exposure to green space as a possible treatment for ADHD. This case study also investigates the relationship between the sunlight and concentration of children with ADHD and aims propose interior design solutions for all the children with or without ADHD.

Riddle et al. (2013) states in their study with 207 children that, despite treatment with medication very young children with ADHD show high symptom severity and impairment. Children with ADHD were assessed for six years and evaluated by three follow-up assessments by parents and teachers who rate symptom severity and diagnoses. Results show that girls showed generally steeper decreases in symptoms.

At year six, 89% of remaining participants met ADHD symptom and impairment diagnostic criteria. The study showed that ADHD in preschoolers is a relatively stable diagnosis over a six-year period.

According to the National Autistic Society (2016), ADHD and autism are common in the basis of some symptoms like both they have significant difficulties with things like poor attention, overactivity and impulsiveness, disorganization, forgetfulness, procrastination, time management problems, and premature shifting of activities. Kotte (2013) express that 18% of children with ADHD exhibited behavior traits of Autism. American Psychiatric Association stated in 2013 that, these two conditions can co-occur.

Klassen (2004) stated in her study that, ADHD has a significant impact on many areas of health and health-related quality of life (HRQL) of children and adolescents with ADHD. With a cross-sectional survey, multidimensional child health questionnaire, and assessments by psychiatrists for physical and psychosocial health measurements were done with 165 respondents of 259 eligible children. Results show that children with ADHD who have more symptoms have poorer HRQL and have more problems than others who have fewer symptoms, compared to emotional-behavioral role function, behavior, mental health, and self-esteem.

The aim of treatment for ADHD is to decrease symptoms and improve well-being for children. Generally, the focus point of the treatments is symptom reduction, but on the other hand, other health problems also should be taken into consideration measured by health-related quality-of-life (HRQL) questionnaires. HRQL is resultant of health status, functional status, and overall quality of life including categories of physical health, psychological health, physical functioning, social functioning, role functioning, and general well-being (Linder et al 2003).

A study applied to measure HRQL in a clinic-based sample of children who had a diagnosis of ADHD and consider the impact of two clinical factors, symptom severity, and comorbidity. The study shows that ADHD has a significant impact on multiple domains of HRQL in children. The demonstration of a differential impact of ADHD on health and well-being in relation to symptom severity and comorbidity has important implications for policies around eligibility for special educational and

other supportive services (Klassen et. al, 2004).

Wiggs (2004), states that the reported rates of sleep disorders in children with developmental disorders such as ADHD and Down syndrome are higher than the rest. In the study, sleep disturbance is said to be one of the reasons for possible daytime difficulties. Thus, Corkum (1998), analyzed the relationship between sleep disturbances and ADHD by an empirical research with a "box-score" approach that examines the outcome measures. As a result, children with ADHD displayed more movements during sleep but did not differ from normal controls in total sleep time.

O'Brien et al. (2003) expresses that, there is a relationship between objectively measured sleep disturbances and neurobehavioral function in children with ADHD. The survey about child's sleeping habits is applied to parents of five to seven-year-old children who had neurocognitive tests. Children are grouped as children with ADHD and children of the control group. They all invited to the Sleep Medicine Center for a night with their parents. Children showing mild symptoms of ADHD have a high prevalence of snoring and rapid eye movement disturbances. As a result of the study, it shows that sleep disturbances can affect diagnosis and treatment of children with ADHD because inadequate sleep results in tiredness and daytime difficulties with focused attention, learning and impulse modulation (O'Brien et al., 2003)

Lack of sleep causes children to be stressful, nervous and stubborn so they show similar behavior as children diagnosed with ADHD. These behavioral problems linked to nighttime breathing difficulties are more likely a result of inadequate sleep than possible oxygen deprivation. One of the latest studies suggesting a link between inadequate sleep and ADHD symptoms, followed 11,000 children for six years, starting from when they were 6 months old. The children whose sleep was affected by breathing problems like snoring, mouth breathing or apnea were 40 percent to 100 percent more likely than normal breaths to develop behavioral problems resembling ADHD. As many as 70% of children with ADHD have been reported to display mild to severe sleep problems such as difficulty falling asleep. In addition, psychiatric comorbidities and medication used both increases the prevalence of sleep problems in ADHD (Wise and Gruber, 2016).

Compared to children with ADHD having no sleep problems, children with ADHD who have sleep problems are more likely to have poorer QoL and daily functioning as well as severe ADHD symptoms. A study examined the efficacy of a behavioral sleep intervention for children with ADHD and relationship between sleep problems and WM in children aged 5–13 years with ADHD. Children with ADHD were chosen according to their having hyperactivity symptoms have a moderate to severe sleep problem by parent report. Cross-sectional data for intervention and control children were pooled at 6 months post-randomization for the analyses. During the study, children's sleep was assessed by a parent with the children's sleep habits questionnaire and self-reports. Also, WM was measured using the WM test. As a result, self-reported sleep problems verity was associated with low WM while parent-reports shows sleep problems were less associated with poorer WM with the exception of bedtime resistance problems (Sciberras et al., 2015).

Another study was applied to 100 middle school-aged youth with ADHD and evaluated by self-reports about daytime sleepiness. The result shows that daytime sleepiness was significantly related to academic impairment (Langberg et al., 2013). Aside from all, children with insufficient or poor-quality sleep have increased impulsivity, hyperactivity, and aggressiveness as well as having problems with academic performance and neurocognitive functioning. It has thus been postulated that children with ADHD and sleep problems could have poorer cognitive and behavioral outcomes than children with ADHD with no sleep problems (Sung et al. 2008).

2.5.2.1. Prevalence of the ADHD

Children are often diagnosed between ages 6-12, and this age group contains a higher proportion of children with ADHD. The worldwide prevalence of ADHD consists of approximately 5% of all children (Polanczyk, 2007). Worldwide, 175 research studies on ADHD shows that the prevalence of ADHD in children aged 18 and under is estimated to be 7.2%. The US Census Bureau estimates 1,795,734,009 people with ADHD were aged between 5-19 worldwide in 2013. Approximately 7% of this total population is 129 million children worldwide with ADHD (The National Resource on ADHD Organization, 2016).

Ercan (2015) stated that ADHD is highly prevalent in Turkish elementary school children. Interviewing 419 primary school children aged 6–14 years old, using K-SADS-PL (Schedule for Affective Disorders and Schizophrenia for School-Age Children Present and Lifetime Version) which is commonly used for assessment of these children to specify psychiatric diagnoses, the results show that the prevalence rates of ADHD were 21.8% and 12.7 % in children without and with impairment, respectively. Nevertheless, in Turkey, statistics, institutions, and centers about ADHD are not widely found. Neither foundations like Turkey Association of Children and Adolescent Psychiatry, Turkey Statistical Agency, nor some private psychiatrists, have results about ADHD focus groups. According to the latest published reports, 1.8% of children aged between 0-6 are diagnosed with ADHD in Turkey (Turkish Statistical Institute, 2012).

Percentage of discomforts apparent in children by sex and residence, 2012
Children in 0-6 age group (%)

	Turkey			Urban			Rural		
Discomforts	Total	Male	Female	Total	Male	Female	Total	Male	Female
Hearing loss	6.0	6.4	5.7	6.6	7.2	6.0	4.8	4.6	5.0
Visual loss	1.4	1.2	1.6	1.4	1.4	1.4	1.4	0.6	2.2
Speech delay and speech defect	4.2	5.1	3.4	4.3	4.9	3.7	4.1	5.3	2.7
Attention deficit, hyperactivity disorder	1.8	2.2	1.4	1.9	2.1	1.8	1.5	2.4	0.5
Behavioral-adjustment problems	1.9	2.8	0.9	1.8	2.6	0.9	2.0	3.0	0.9
Other(1)	3.1	2.8	3.3	3.4	3.1	3.6	2.5	2.2	2.8

(1) Mental retardation, learning disabilities, cerebral palsy, autism and congenital dislocation of the hip have been included in other.

Table 2.1: Prepared by Turkish Statistical Institute inducting the percentages of discomforts in children aged between zero to six

2.5.2.2. Diagnosis and Treatment of ADHD

ADHD symptoms can appear between the ages of three and six and can continue through adolescence and adulthood. In preschool children, the most common ADHD symptom is hyperactivity and the combined type. Diagnosis can be done if the children have these symptoms for at least 6 months. The child should also be checked for other conditions such as vision, hearing, or sleep problems as sometimes

the symptoms are common with ADHD and may cause wrong diagnosis (The National Resource on ADHD Organization, 2015).

The diagnosis of ADHD requires a series of tests such as Neurocognitive Test, Test of Variables of Attention (T.O.V.A), Conner's Continuous Performance Test (CPT) and Intermediate Visual and Auditory Continuous Performance Test (IVA). These tests are applied by experts but cannot diagnose with %100 certainty (Accessed, Ersoy, 2012).

Scientists are not sure what causes ADHD, but the possible risk factors are explained as genes, smoking, and use of alcohol, exposure to toxins during pregnancy, low birth height, and brain injuries. ADHD is caused by chemical, structural, and connectivity differences in the brain, mostly as a result of genetics (Frank, 2016).

It is said to be there is no cure for ADHD, but there are some possible treatments which can help reduce symptoms and improve functioning such as medication, psychotherapy, education or training, or a combination of treatments (NIMH, 2016). The most effective treatment for ADHD is a combination of medication and therapy as medication helps to regulate brain-based functions and symptoms while therapy leads to thoughts, behaviors, and coping strategies (Frank, 2016).

The National Resource on ADHD Organization (2015) reminds that treating for ADHD needs continuity, monitoring children periodically, and repeating the rating scale assessments in order to see as if the treatment is working properly. The rrating scales to be designed to focus on ADHD symptoms and can determine the presence of core symptoms of ADHD as defined by the Diagnostic and Statistical Manual (DSM-5) criteria for ADHD. Some of ADHD rating scales for children include Parent-completed Child Behavior Checklist, Teacher Report Form (TRF) of the Child Behavior Checklist, ADD-H: Comprehensive Teacher Rating Scale (ACTeRS), Barkley Home Situations Questionnaire (HSQ), Barkley School Situations Questionnaire (SSQ), Vanderbilt scales, Conners scales, ADHD Rating Scales (ADHD-RS-V), and Swanson, Nolan and Pelham (SNAP) scale. Parents and caregivers can learn how to manage these children by receiving parent behavioral training that provides behavioral techniques, necessary tools, and strategies to help children with ADHD.

2.5.2.3 ADHD, Attention, and Concentration

Kaplan (1995), states that nature takes the human mind away from daily stressors and helps mental exhaustion resulting from having the difficulty of focusing on tasks and being easily distracted. Natural environments improve attention, especially for children with ADHD. Being outdoors in a green space helps people recover from attention fatigue. Taylor and Sullivan (2001), state that children's contact with nature increases attention and conclude that children need less support for attention after green area activities.

White (2004) says that contact with nature helps children's cognitive development, improves awareness and observational skills as well as contributing to concentrate better. Physical activities like playing, running, and sports help spend extra energy and feel less restless that provides a child to focus easier.

Children with ADHD generally have also working memory (WM) deficit based on an impairment of the frontal lobe. WM capacity is the ability to hold up information during a short period of time. In the study, children with ADHD were trained of WM tasks to be evaluated, and as a result, training significantly enhanced performance on the WM tasks. Training even improved performance on a non-trained visuospatial WM. WM training can be the use of clinically for eliminating the symptoms in ADHD (Klingberg et al., 2002).

Nour El Daou and El-Shamieh (2015), investigate the effect of playing chess on the concentration of ADHD students and explain that chess improves concentration period and listening language skills. Chess is a game that requires focus and is an easy game to focus on for a long period of time for kids and adults alike. During a chess game, a large amount of concentration, attention, and focus is required to achieve victory and so it helps by forcing children with ADHD to pay attention or losing the game.

2.5.2.4. Sunlight, Nature, and Development of Children with ADHD

Arns et al. (2013), tries to find the relationship between ADHD prevalence rates and the sunlight intensity levels of particular regions. The study shows that areas with high sunlight intensity have a lower prevalence of disorder so it is explained that

high sunlight intensity may be helpful and protective for ADHD. There is a relationship between the prevalence of ADHD and solar intensity (Arns et al., (2013). The study showing classrooms with more sunlight inside increases academic success as sunlight provides biological and mental well-being.

Liberman (1991), expresses that several learning disabled children with extreme hyperactivity problems calmed down and could overcome their learning and reading problems while they were in full spectrum lighting classrooms. The study shows that under full spectrum lighting, blood pressure dropped and aggressive behavior reduced significantly.

Morning bright light therapy was associated with a significant decrease in core ADHD symptoms (Rybak et al., 2006). 29 patients with DSM-IV ADHD were selected and a 3-week of morning bright light therapy applied to them. The result shows that MEQ score, which means, "Morningness–Eveningness" questionnaire that aims to measure whether a person's biological clock produces peak alertness in the morning, evening, or in between endogenous melatonin and sleep patterns in children with ADHD, ages 6–12, with or without chronic, was increased. The underlying circadian concept is reinforced by direct measurement of idiopathic sleep onset insomnia. Although morning light therapy for the insomniacs with special attention to ADHD symptoms would be worthwhile also to test the children with normal sleep (Terman, 2007).

The psychological, academic, and physical health of children is positively affected by nature in a variety of ways. Nature affects children's creativity and problem-solving, having developed cognitive abilities, reducing the symptoms of ADHD, and reducing stress (Natural Learning Organization, 2012).

Natural areas provide a consistent positive environment for children with ADHD (Van den Berg, 2010). In a study by Berg, two groups of six children aged between 9–17 were observed, questioned, and tested systematically during their visits to a wooded area and a small town. As a result, both groups performed better on a concentration task in the woods than in the town and some of the children showed more aggressive, inattentive, impulsive and hyperactive behavior in the town than in the woods.

Kellert's study (2005) investigates the physical and mental well-being of children by connecting the case with experience of nature, particularly for children's emotional, intellectual, and evaluative development. Additionally, White's (2015) states that children with ADHD can concentrate on contact with nature and children's cognitive development is improving by awareness, reasoning and observational skills.

Kaplan (1989), has proposed that tasks requiring direct attention or inhibit unwanted stimuli, or impulses draw on a shared mechanism that is subject to fatigue. After prolonged or intense use of mechanism, fatigue sets in, and becomes difficult to pay attention and inhibit impulses; that is, the behavior and performance of individuals without ADHD temporarily take on many of the characteristic patterns of ADHD.

Nature has a salutary effect on people with ADHD. Natural activities like backpacking, gardening, viewing slides of nature, restoring prairie ecosystems, and simply having trees and grass outside one's apartment building has been linked to superior attention, effectiveness, and effectiveness-related outcomes (Kuo and Taylor, 2004).

Taylor and Kuo (2001) state that, exposure to green environments reduce children's ADHD symptoms. Their study examines whether or not routine exposure to green space reduces ADHD symptoms through data collection from parents and the results show that everyday play settings make a difference in overall symptoms of ADHD.

Specifically, children with ADHD who play regularly in green play settings have milder symptoms than children who play in built outdoor and indoor settings. The explanation of this situation might be related to spending the over energy and alleviating the symptoms (Taylor and Kuo, 2004).

Interaction with the natural environment allows for exploration, contemplation, planning, and education for children and adults of all ages. Increased exposure to nature derives a range of benefits such as reducing stress level, decreasing symptoms of ADHD, increasing levels of concentration, protecting against myopia and helps the immune system (Nature Play Symposium, 2015).

Exercise both increases dopamine levels in the brain which are naturally low in the brain with ADHD and also improves balance, coordination and motor skills of

children with ADHD. Thus, structured and organized activities with simplified instructions such as art or creative activities, playing tag and yoga may help children with ADHD (Tartakovsky, 2017).

Taylor and Kuo (2011: 5), state that, common after-school and weekend activities done in the natural environments can reduce symptoms of ADHD. In their study, 17 children with ADHD took part in three 20-minute walks in a park, a residential neighborhood, and a downtown area periodically. Routes were chosen intentionally to involve a variety of levels of noise and pedestrian density. Moreover, 15 minutes of puzzle-like tasks were administered to children before each walk. After each walk, children's attentions were measured with a standard test called "Digit Span Backwards", in which a series of numbers are said aloud and the child recites them backward. This test is a way of measuring attention and concentration. The performances of the children on these measuring tests were significantly better after walking in the greenest setting.

Another study shows that physical activity interventions are more effective than the sedentary classroom-based interventions with regards to decreasing the symptoms of ADHD such as inattention and moodiness in the home context. Children were randomly assigned to either physical activity or sedentary classroom-based activity to take part in intervention 31 minutes per day, each school day, over the course of 12 weeks. Parent and teacher rated the symptoms, behavior, moodiness, and peer functioning of children after activities. The analysis shows that physical activity intervention may reduce impairment associated with ADHD risk in both home and school domains. Additionally, it shows before school sedentary classroom-based activity is a potential tool for managing ADHD symptoms (Hoza et al., 2014: 655).

Children with ADHD suffer from movement disorders as well as hyperactivity and lack of attention. Movement disorders may cause high levels of stress and bring sensory-related mobility dysfunctions to children with ADHD. Postural practices can help this dysfunction (Amini et al., 2016). Moreover, physical interventions heighten attention (Rumsey and Anderson, 2002). Jogging improves visual and auditory attention span and decreased hyper behavior of hyperactive boys (Elsom, 1981).

Running may also help impulse control of learning disabled children. Bass (1985)

observed six children aged 8-11 from one learning disabled class after two hours daily on two running and two non-running days within the same week. Behavioral measures of attention span and impulse control were documented after observation. Results show that running has psychological benefits like reducing anxiety, depression, anger, and aggression as well as physiological benefits like releasing hormones and affecting neuronal transmission (Bass, 1985)

This second chapter summarizes the definition of biophilia and explains the parameters of the biophilic design. Sunlight, green environments, activities, body health and positive behavior cases are associated with nature and biophilia as regards to preschool children and learning environments. The chapter gives the definition of ADHD and summarizes the brief information about children with ADHD as it is one of the most common behavioral problems in preschool learning environments.

CHAPTER 3

NATURAL LEARNING ENVIRONMENTS

Parents of preschool children reported that children are usually physically more active outdoors and less active in indoors (Burdette and Whitaker, 2004). That shows that the built environment can affect children's opportunity to access nature and do outdoor activities, as certain factors in these environments encourage children to be more active (McCurdy et al., 2010).

Learning environments with trees, gardens, and nature trails, may affect the amount and quality of physical activity among elementary school children. A study conducted in 59 schools across Canada by surveying teachers, parents, and administrators to evaluate green features in their schoolyards influenced physical activity of students. 70% of respondents indicated that the initiative resulted in increased light to moderate physical activity, and half of them also reported that their green school ground promoted more vigorous activity support a wider variety of activities (Dyment and Bell. 2008).

Moore and Wong (1997) analyze the natural extension of learning environments design and their effects on children's development and positive behavior. Moore investigates the natural extension of the classroom as it leads to decrease in student boredom and antisocial behavior as they became engaged in the landscape by discovering schoolyard as a new outdoor classroom, providing innovative ways of teaching the basics in outdoor settings, and offers ideas on creating engaging play areas that foster positive behavior.

Sanoff and Sanoff (1987), provide guidelines for natural learning spaces for creating effective spaces for children. Each of the activity areas that may be contained in a

children center is described in terms of their objectives, design requirements are stated and an activity factor evaluation chart and advice on playground planning conclude the document. The quality of the school building has a direct impact on student performance.

3.1 Education Models

Architect Tezuka (2014) states that keeping children unorganized, and free, their natural enthusiasm affects their psychology and reduces their stress levels. Being away from stress can help children concentrate better and have better success in development period. In accordance with priorities of the Montessori education method, Fuji Kindergarten provides a flexible and secure framework in order to encourage children with key notions of independence and freedom to choose activities that will help them understand their environment and participate in daily activities, individually and collectively. Instead of traditional tests and measurements of achievement, this method encourages children to develop skills by doing activities that use the five senses. In response to Montessori education, Fuji Kindergarten provides no hierarchy or order, but an ideal context for such activities and developments to children with its simple structure creating a wide variety of environments without dead ends or unmanageable hidden areas. As a basis of Montessori education method, this kindergarten encourages children to interact with nature by consisting animal shelters and small gardens where children can plant vegetables or flowers. The design of the building ensures continuity between inside and outside (Education in Japan, 2010; Edwards, 2002).

The State Board of Education Department of Public Instruction Public School of North Carolina (1998) state that there are challenges for designers for designing learning environments and gives designers planning guidelines by defending that children should be free, activity areas should be divided for not to be distracted. Additionally, it is expressed that the use of natural materials can help children experience the reality and focus on their tasks better as well as natural light.

3.1.1 Social Environment

Bagot (2014) experimented with 550 Children from 14 schools in Australia and

examined children’s perception of playground restorativeness and play period experiences as regards to affecting, physical activity, social activity, perceived affordances. The assessment was done by photograph ratings through playground characteristics suh as nature, size, play areas, play equipment and the ratio of total grounds. After controlling for gender, age and playground size, vegetation volume was the only significant naturalness measure predicting perceived restorativeness. Play period experiences explained more variance than physical characteristics. Three potential contributors to perceived restorativeness are stated as natural elements such as trees, shrubs, grassy spaces, the presence of non-natural physical characteristics of the playground such as play equipment, seating areas, and children's play period experiences such as levels of physical activity, social activity.

Attention restoration theory (ART; Kaplan and Kaplan, 1989; Kaplan, 1995) links the perceived restorativeness of environments specifically to the restoration of attention resources but also incorporates stress reductions as a potential pathway to restoration (Kaplan, 1995). For an environment to be restorative, ART proposes that four components as being away (physical or psychological), compatibility (with purpose), fascination (cognitive or physical) and extent (scope and connectedness). Each of the theoretical components addresses a different aspect of what makes an environment potentially restorative and literature indicates that adults generally report higher levels of each the restorative components in more natural spaces than built spaces.

3.1.2. Physical Environment

Martel (2016) states, elements of a physical environment such as light, color, interior design, temperature, and energy distribution significantly improve or block learning performance of individual and group.

An observational study of Czalczynska-Podolska (2014) on child behavior is conducted in ten contemporary public playgrounds shows that the play environment influences child behavior and selected feature categories can determine a playground’s playability and sociability. Type, quality, and diversity of play environments affect children’s play as well as behavior so a well-designed playground may help children’s developmental skills. Traditional playground limits

children's functional play and promotes competition rather than cooperation. On the other hand, contemporary playgrounds foster dramatic play. Key features of outdoor play environments in relation to developments are listed such as character, context, connectivity, change, chance, clarity, and challenge. Creating semi-private spaces encourages a form of dramatic play and increase the duration of child involvement. Playgrounds should be designed as play environments which develop children's physical, social, emotional and cognitive development thus appearance, usage and arrangement should be taken into consideration while designing as these features influence children's behavior on playgrounds (Czalczynska-Podolska, 2014)

Good natural light helps to create a sense of physical and mental comfort owing to its diffused quality and its subtle changing value and color, that electric lighting does not have (Barrett et al., 2015: 18). Tanner's (2009) study with 71 US elementary schools, examines the impact of the school's physical environment on aspects of effective, behavioral, and cognitive learning. Results show that physical environment parameters like natural light or classroom view affect scores on tests.

3.2. Learning Environments and Task Concentration

The reason of why visual comfort in learning environments and buildings is crucial is that students spend about 30% of their time in these places. Visual comfort in schools increases health and wellbeing as well as learning and visual performance. Sunlight as a visual sensory element of learning environments plays an important role in achieving comfort. Sunlight can influence reading, task involvement, productivity, sense of wellbeing, mood and health, comfort, perceptions of space, emotions, students' experiences, and behaviors. As well as sunlight, the view should also be considered as a part of visual comfort. Thus the amount of view and quality of view is important points to be taken into consideration while designing learning spaces (Korsavi, 2016).

Avoiding direct sunlight penetration on the working plane, and avoiding sources of glare in the student's visual field is important while designing a learning environment. Moreno and Labarca's (2015) study in Santiago shows that classrooms with an upper blind provide appropriate lighting for students in this region and provides energy saving that almost does not require supplemental artificial lighting.

Rasberry et al. (2011) state that there is an association between school-based physical activity, academic performance, cognitive skills, and attitudes and achievement. The study gives implications for schools in order to maximize the benefits of student participation in physical education class, increasing the time spent for physical activity inside and outside the class and designing the whole learning spaces accordingly (Centers for Disease Control and Prevention, 2010).

Classrooms' physical features and design affects children's learning and academic progress. Examining 153 classrooms in 27 diverse schools shows in common that significant design parameters such as light, temperature, air quality, ownership, flexibility, complexity, and color are related to academic progress. In this particular case, the "naturalness" design principle accounts for around 50% of the impact on learning. Designers may benefit from guidelines of this study which expresses using large glazing is welcomed when it is towards the North as it provides sunlight throughout the day and year and seldom results in problems with glare discomfort. Also, it is mentioned that classrooms facing the East and West can receive abundant sunlight and have a low risk of glare during the normal times of occupation. Expansive glazing should be avoided when it is orientated South, towards the sun's path for most of the year. When large glazing is applied towards the South, external shading should be provided to control the degree of sunlight penetration. Moreover, abundant and high-quality electrical lighting is essential to provide a reasonable visual environment (Barrett et al., 2015).

The design of the learning environment as regards to design parameters such as color, choice, complexity, flexibility, and light has a significant effect on learning. A study was conducted over the 2011–12 academic year, with 751 students in 34 classrooms, spread across seven primary schools in the seaside town of Blackpool, England. After collecting data on the students, University of Salford School of the Built Environment, in Manchester, England and architecture firm Nightingale Associates ranked each classroom on a 1 to 5 scale for 10 different design parameters: light, sound, temperature, air quality, choice, flexibility, connection, complexity, color, and texture. Choosing the right furniture for the learning environment is important on the basis of being ergonomic and efficient as well as complexity and color affects perceiving visual stimulation (Vanhemert, 2013).

A study of Heschong and Mahone (1999) compared the performance of elementary school students in similar buildings with a range of sunlight conditions. The elementary school provides data about student scores on both math and reading standardized tests for all children between grades two to five as well as providing data about classroom characterizations of window lighting, sky lighting, and sunlight. Results show that the classrooms with the most amount of sunlight are seen to be associated with a 20% to 26% faster learning rate. The increased results of student's tests in one school year, and in comparison to classrooms with the least amount of sunlight prove that classrooms with skylights and operable windows are seen to be associated with 15% to 23% faster rate of improvement when compared to classrooms with the least amount of windows.

Costanzo (2017) states that sunlight improves the visual comfort of occupants while contributing energy performance of the buildings. Sunlight in learning spaces should have good spectral quality as it has an impact on the circadian system and thus concentration. The climatic location of the classroom is important as regards to welcoming a sufficient amount of sunlight and responding to the needs of classrooms in terms of sunlight. Focusing on the classroom's layout helps sunlight optimization. Moreover, the amount of sunlight should be sufficient for students and teachers to accomplish their visual tasks properly. Sunlight should also be distributed to the classroom carefully as excessive distribution may force students because of glare problems which can be avoided with the help of suitable shading devices.

A survey of Heschong and Mahone (1999) shows that side-lit classrooms with delightful views including vegetation or human activity support better outcomes from students while sources of glare such as windows and chalkboards especially if black or green color negatively affect students' performances. Moreover, direct sun penetration from unshaded east- and south-facing windows is associated with worse students' outcomes, as it is likely to cause glare and thermal discomfort.

3.2.1. Learning Environments

The academic success of children is influenced by different variables. Steelcase Education studies in collaboration with academic researchers in Canada and the United States shows that classrooms that physically support students also affect

student engagement. A study by Scott-Webber (2001), was made with Active Learning Post Occupancy Evaluation (AL-POE) which is a tool for measuring the impact of classroom design on student engagement. The students were compared to their experiences in a standard classroom and a classroom specifically designed for active learning after they had enough time to experience both spaces. Results show that well-designed spaces where physical space supports a focus on engaging experiences for students support a highly positive and significant impact on student engagement, improved active learning, motivation, and creativity (Scott-Webber, 2001).

Chan and Petrie (1999), examines how school designs can facilitate learning environments in order to make students actually learn and succeed. It is said that learning can be supported by an artistic environment, spacious learning areas, color and lighting, and optimal thermal and acoustical environments.

O'Donnell et al. (2010) propose tips on designing for children's learning environments. Limited classroom sunlight affects children in a negative way, and cause outperformance by children than those who are studying in natural light. Thinking as children and designing for their safety in these environments is crucial. In the book designing for everybody is stated as there are some children with different physical or psychological conditions studying in the same environment. The effect of the participatory design is also explained as adding them to the process is very important. Displaying their works and making them feel as a part of the spaces and community. Naturalizing play spaces by increasing contact with grass and plants can be provided by creating indoor-outdoor unbounded spaces with windows, doors, walls etc. Also keeping pace with providing environmental experiences is stated.

Additionally, Nair, et al. focus on and give guidelines for creating learning environments focused on architectural and landscape features (2009). Sanoff (1995) states that physical environment is important for child development and behavior. The physical space requires responding children's needs and privacy. In his study, he touches upon components like playgrounds, materials, light, and color, and planning the facilities. Sanoff states that fluorescent lighting reduces shadows and shading, thus affect children's visual perception. Thus, preschool environments should have a

variety of lighter and darker areas and need a large proportion of sunlight entering from more than one direction to avoid high contrasts which make the eyes work too hard to identify and complete tasks.

Ostrosky and Meadan (2010) defend that, while designing the classroom's physical environment, two factors should be taken into consideration such as strategies to promote engagement and ideas for preventing challenging behavior as effective physical environments can enhance children's learning. Preventing space from over-crowded, and to separating noisy spaces from each other could help children to concentrate on their play and learning. Display images and photographs may highlight important social-emotional skills. There should be enough centers to allow children to communicate and support their social interaction.

Specific factors such as air quality, temperature, lighting, and acoustics contribute to performance levels of students (Blazer, 2012). Poor air quality causes difficulty in concentrating (Baker and Bernstein, 2012). Appropriate lighting affects achievement of students in a positive way while poor quality lighting causes students perform less than others in properly illuminated school buildings (Earthman, 2004). Controlled sunlight, combined with appropriate artificial lighting when needed, provides students with the best lighting conditions (Baker and Bernstein, 2012)

Students without access to natural light show delay in seasonal cortisol hormone production which is positively associated with concentration abilities (Kuller and Lindsten, 1992). When compared to students in windowless classrooms, students in sunlit classrooms had better improvement on standardized math and reading tests (scored better from 7% to 18% than the others) as a result of the relationship between academic achievement and classroom views to the outdoors (Heschong and Mahone, 1999; 2003).

Korsavi's study (2016) with 60 female 15 years old students occupying north and south facing classroom aims to tests students' evaluations on visual comfort through questionnaires in sunlit and non-sunlit areas in classrooms in a typical high school in Kashan. According to simulation, classroom facing to north and south have been divided into sunlit and sunlit areas in order to make students evaluate sunlight based on their position in the classroom. Results show that while students‟ evaluation about

sunlight availability in sunlit areas is mostly positive while sunlight availability in non-sunlit areas is neutral. The questionnaires show a wider range of sunlight acceptance in a south facing classroom and visual comfort in a north facing classroom than simulation results. Configurations of windows, expectations, and region may also change the degree of comfort experienced in each space.

Katerina (2012), examines the importance of architectural elements in relation to the learning environment, focusing on natural light. There are positive effects of taking advantage of natural light in architectural design and learning environments. Katerina states that students' performance, health the aesthetic and efficient quality of space have positive effects on learning environments. In order to create high-performance learning environments, natural light should contribute.

The application of ergonomics into the environments of all areas has proven to increase success, performance, productivity, competitiveness, and safety and health, and one of these areas is the learning environments. Ergonomic design of the learning environment influences learning performance (Smith, 2007)

Reggio Emilia gives both children and adults the chance of constructing their knowledge through interactions with people and the environment. One of the key principles of the Reggio Emilia schools is building on the premise that each child has the desire to connect with others, to engage in learning, and to enter into a relationship with their environment. This approach identifies the environment as ‘’a third teacher’’ between child, teacher, and parent in education (Strong-Wilson and Ellis, 2007).

Characteristics of learning environments are important for children to invite them to explore and support motivation and provide communication with their world. The physical environment as indoors and outdoors affects development and growth of children and adults, including those with additional needs. Learning environments should offer children opportunities to do a variety of activities themselves or with groups to explore for fun, adventure, challenge, and creativity as well as give space to move, dance and increase control over their bodies (Hohmann and Weikart, 1995).

The characteristics of adequate learning environments change according to age

groups and require to be safe, clean, spacious, bright, welcoming, warm and accessible. Montessori learning method advocated that the learning environment should be designed to meet children's needs as much as possible to work independently, to make choices, decisions and solve problems, to engage in real experiences and to experience success. Moreover, Steiner's Waldorf education method promoted a variety of easily accessible, natural and real-life materials which can be used in creative and purposeful ways and reflect children's family lives. The most effective learning comes from simple but versatile materials and environments which support children's imagination (French, 2007).

3.2.2. Learning Environments and ADHD

Universal design is designing all products, buildings and exterior spaces to be usable by all people with or without disabilities to the greatest extent possible (Mace et al., 1991). Designing responsive environments with Universal Design principles facilitates the environment and improves usability, as well as optimizing user experience (Petrie et al., 2016). Universal design can be used to assist children with physical, effective, or cognitive barriers in a way that they do not feel stigmatized or isolated from others (Pisha and Coyne, 2001). Study with the participants consist of trainers and teachers shows that participants recognized that students are engaged better in the learning process when the instructions are more effective with universal design parameters especially for children with special needs like ADHD (Hitchcock, et al., 2002).

Mulrine (2008) states that, students need to keep their concentration alive in learning environments but especially those who are with ADHD also need to provide impulse discharge and control impulsivity. Establishing a classroom environment that encourages beneficial movements during the day content lessons, transitions, specialized games for recess and activities can improve results for children with ADHD. These children are generally disorganized and so they have poorer attention. Teachers need to do exercises during classes and parent need to lead their children to do after school activities like playing, running or gardening otherwise these children continue having problems related to attention because of remnant energy (Mulrine, 2008).

Steiner (2011) examined the efficacy of computer-based training systems to teach children with ADHD to attend more effectively. 41 children with ADHD were randomly selected and received 2 sessions a week at the school of either neurofeedback (NF) or attention training through a standard computer format (SCF). Parents, children, and teachers completed questionnaires before and after the intervention. Results show the effectiveness of computer-based interventions for children with ADHD (Steiner et al., 2011).

Rizzo et al. (2000), proposed that virtual reality can be used in the assessment of attention as well as cognitive training and can offer predictive information regarding performance in the real environment.

Virtual Reality technology helps to remove distractions and increase the ability to concentrate for a longer period of time. Attention Enhancement System is a prototype developed by Cho et al. (2002) with virtual reality technology and EEG biofeedback, and it possesses the ability to improve attention span of children.

Dalton (2013) remarks that architecture can be a response to human needs within the built environment, by facilitating more intuitive and inclusive user interaction, addressing ease-of-use, improving both functional and psychosocial fit, and satisfying sensory, and aesthetic considerations. He adds that an adaptive sensory environment also helps people with special needs. Moreover mapping interaction design techniques and using persona is a useful exercise in deriving a set of basic design principles for an interactive environment for a user with autism that has a common basis with ADHD.

Carbone (2001) discusses the arrangement of the classrooms furnishings, equipment, activity areas, and supplies to address ADHD students' issues with hyperactivity, impulsivity, distractibility, and disorganization.

Alkahtany (2014), in her research, tries to create sufficient spaces for children with ADHD by integrating furniture design and principles with sustainability, materiality, colors, textures, and forms in order to increase positive learning space behaviors and success. She explains children with ADHD often have difficulty to adapt to the classroom or activity, are easily distracted and also have difficulty about senses and

communication. Architectural design helps to activate the humanity benefit by achieving basic design criteria such as beauty, materials and techniques and occupation. A complex interior or architectural design can create stress for people with ADHD while clear planning and organization of space help increase the efficiency and effectiveness of the use of the building.

Even furniture affects children as well as other distractions like walls, board etc (Alkahtany, 2014). Therefore, children's learning spaces should be designed accordingly with paying attention to seatings, sound, lighting, and temperature preferences. Simple color gradation connecting the color of the walls, floor, and ceiling facilitates self-control, provides a sense of security and greater calm in the space, increases concentration, and eliminates distractions.

natural lighting is one of the important elements that achieve adequate lighting of the area, which consists of forms characterized by force natural lighting any building can raise morale. Moreover, new sustainable flooring that can be exploited to take advantage of the kinetic energy of users with hyperactivity and distracted attention (Alkahtany, 2014).

3.3 Learning Environments in Relation to Nature and Sunlight

From all over the world there are learning environments in good relation with nature and sunlight as it is widely known that this relation affects children's learning skills and mental and physical health.

'Spring' Early Childhood Learning Centre as demonstrated in Figure 3.1 is designed by Joey Ho Architects. The learning center is in Hong Kong. Interior of the Centre is bright at the appropriate level for a learning environment owing to it's design layout and material selection as Dalton (2013) remarks that architecture can be a response to human needs like seen in this project. The windows in the interior allow direct use of sunlight and air flow. At the same time, the exterior view formed by trees is clearly visible from the windows which have positive affect on all human beings.

Figure 3.1: ‘Spring’ Early Childhood Learning Centre in Hong Kong

Source: Spring / Joey Ho Design www.archdaily.com/485970/spring-joey-ho-design

Figure 3.2: Kensington International Kindergarten in Bangkok in Thailand

Source: Kensington International Kindergarten / Plan Architect www.archdaily.comhttps://www.archdaily.com/383780/kensington-international-kindergarten-plan-architect

Kensington International Kindergarten as shown in Figure 3.2 is designed by Plan Architect in Bangkok, Thailand. The architecture of the kindergarten provides opportunity for children to experience the nature easily as there is an indoor and outdoor relation upon plan. Sunlight directly spread to inner garden of the kindergarten through the roof aperture. Moreover, the classrooms gets sunlight thanks to high windows which enables children to learn more active and to be more focused in bright environment.

Neufeld an der Leitha Kindergarten as demonstrated in Figure 3.3. is designed by Solid Architecture in Leitha Austria. Highrise windows in the classrooms allow children to benefit from sunlight. Owing to a pergola with wooden slats attached to the roof the building is protected from both excessive glare and overheating. The relation between inside and outside is balanced by the roof extends and children are able to see natural elements from inside.

Figure 3.3: Neufeld an der Leitha Kindergarten in Leitha, Austria

Source: Neufeld an der Leitha Kindergarten / Solid Architecture www.archdaily.comhttps://www.archdaily.com/164974/neufeld-an-der-leitha-kindergarten-solid-architecture

Ring Around the Tree Fuji Kindergarten (Figure 3.4) is designed by Tezuka Architects and located in Tokyo. The best possible use of sunlight and nature is applied in this kindergarten design. The architecture is grounded on a natural landscape that is intended to provide children freedom and well-being requirements. Transparency is the key concept and applied within doors and windows which allows children to be connected to nature and sunlight.

Figure 3.4: Ring Around the Tree Fuji Kindergarten in Tokyo

Source: Lynch, P. 2017. Tezuka Architects' Fuji Kindergarten Wins 2017 Moriyama RAIC International Prize www.archdaily.com/880027/tezuka-architects-fuji-kindergarten-wins-2017-moriyama-raic-international-prize

Raa Day Care Center is designed by Dorte Mandrup in Helsingborg, Sweden. As a result of the geographical position of the building there is need for sunlight as much as possible. For that reason the glazings are as wide as possible in order to get the required level of sunlight inside. In order to respond the need in the best way, windows are supported with the skylight.

Figure 3.5: Raa Day Care Center in Helsingborg, Sweden

Source: Råå Day Care Center / Dorte Mandrup Arkitekterwww.archdaily.com/570507/raa-day-care-center-dorte-mandrup-arkitekter

Froebel Kindergarten (Figure 3.6) in İstanbul is designed by DDA Architects. The kindergarten has its own garden full of natural elements such as grass, trees and soil. Children areable to contact with both sunlight and natural elements. Indoors are also associated with outside by the agency of windows.

Figure 3.6: Froebel Kindergarten in İstanbul

Source: Fröbel İstanbul www.froebel.com.tr

This third chapter summarizes the social and physical learning environments of preschool children with and without ADHD. The chapter analyzes how learning environments affect children with their characteristics and features as well as the educational models. Moreover, 6 sample learning environments in good relation with nature and sunlight are examined in this chapter.

CHAPTER 4

DESIGN OF THE STUDY

With this study, the role of the sunlight on preschool children's focus is evaluated and eventually, the design proposals are declared in order to contribute to the preschool learning environments by directing referrals from the study. Data were collected in Buca Bayındır Preschool in İzmir from 18 participants at the age of 6. The evaluation was done through questionnaires and teacher reports. Children are evaluated with their given numbers, names kept under privacy.

Although Regulations for preschool environments are reported by Turkish Ministry of Education (2015), the report called Educational Buildings Design Standards, 2015 contains limited information about interior design. This affected the study as there is not enough ready guidelines to chase thus in the conclusion chapter there proposed several design proposals according to the implementations of the study for related designers.

This case study intended to include both children with and without ADHD. Various methods developed, interviews were held with psychologists, psychiatrics, corporate managers from preschools both in İzmir, İstanbul and Milan. Thus the conditions were not appropriate and the case study includes just children without ADHD.

4.1. Participants

Preschool's manager confirmed the application in the name of children's parents as regards to usage of information and photos. Two different classes are combined in order to get the intended number of participant children. Both of the classes are at the same education level.

18 children and three teachers have involved the study (Figure 4.1). Children were at

the age of six. This age group was preferred for the study because of their social relationships, the ability to communicate easily and to express themselves easily (American Academy of Pediatrics, 2006).

Names were and will be kept hidden through all the study outcomes. The names of the children were not be recorded. The numbering style was used in all evaluation steps of the application, thus the results were be explained by the numbers of children.

Figure 4.1: Participants

Source: Photography by the author

4.2. Site

Buca Bayındır Preschool is located in İzmir, Turkey (Figure 4.2 ; 4.3). This private preschool provides full-day education to children aged between three to six. The building of the school has three stories and a small side garden. The classroom of the application is 23 square meters and facing east.

Figure 4.2: Map of the research preschool in Turkey

Source: www.google.com/maps

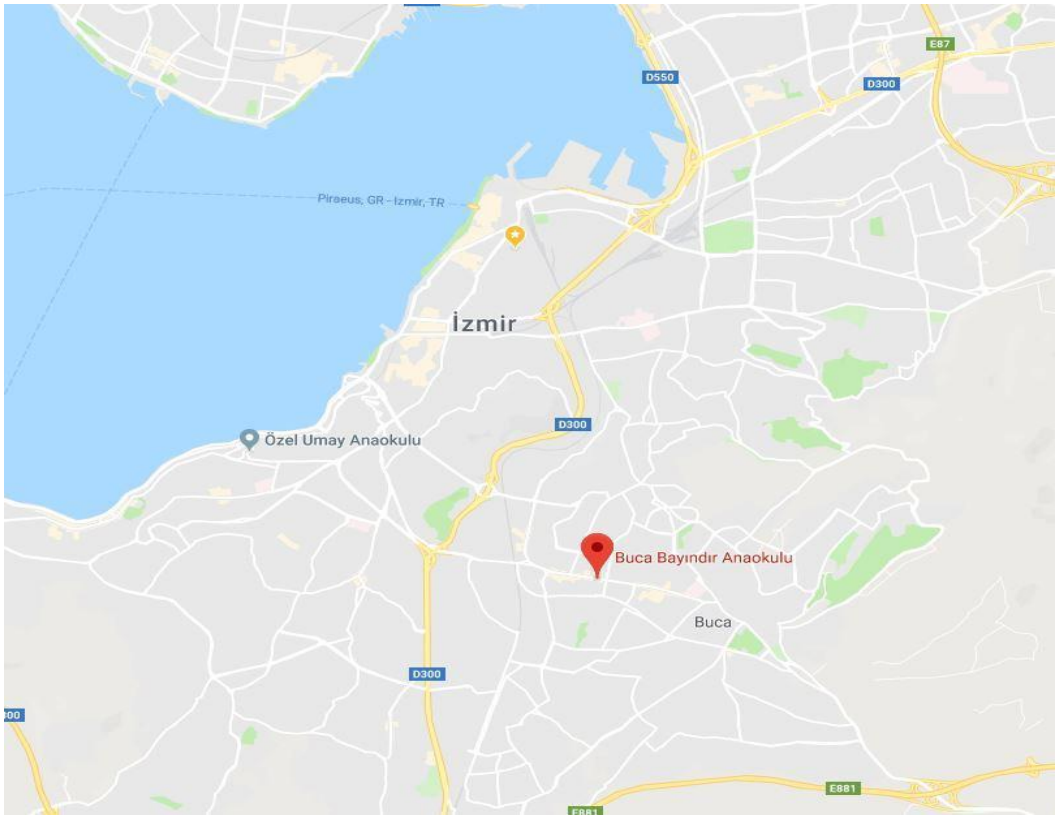

Figure 4.3: Map of the research preschool in the city of İzmir

Source: www.google.com/maps

There are two windows in the classroom. Figure 4.4 indicates window-1 which has dimensions as W:210cm.X.H:120cm. Figure 4.5 shows window-2 with the dimensions of W:140cm.X.H:120cm.

Figure 4.4: Window-1

Source: Photography by the author

Figure 4.5: Window-2

Source: Photography by the author

4.3. Methods and Materials

In order to evaluate the role of sunlight on preschool children's focus, a scale model of the classroom from Buca Bayındır Preschool is prepared. A questionnaire is prepared for both children and teachers. Three teachers evaluated children with teachers' questionnaire adopted from Prof. Dr. Eyüp Sabri Ercan's Attention Deficiencies Hyperactivity Disorder Measurement-Teacher Form (Ercan, 2017).

4.3.1. Model

1/20 model is made according to the size of their classroom to ask how children were affected by sunlight through their window preferences in their class. 1/20 model of the classroom from Buca Bayındır Preschool is prepared. Variables are eliminated thus the model was abstract and there were only white cubes and geometric forms instead of specific furniture (Figure 4.6.). The focus was on windows which directly affects sunlight coming inside the classroom.

Figure 4.6: 1/20 scale abstract model

Source: Model and photography by the author

For two of the walls, there proposed two alternatives per window. Each window choice has a different size than others (Figure 4.7). Two of them are the real size models of the windows in the classroom. Their sizes are W:210cm.X.H:120cm and W:140cm.X.H:120cm. Four of the others are sized as; window-3 W:210cm.X.H:210cm ; window-4 W:300cm.X.H:210cm ; window-5 W:140cm.X.H:210cm ; window-6 W:240cm.X.H:210cm.

Figure 4.7: Sample of window variations with different sizes

Source: Model and photography by the author

4.3.2. Questionnaire

A questionnaire was prepared for both children and teachers.

4.3.2.1. Children's Questionnaire

An imaginary classroom 3D model was drawn in the program SketchUp+Vray 2017 and rendered. Renders show the same classroom with three different lighting settings from the same angle. In the first scene (Figure 4.8) the classroom is illuminated by artificial lighting fixtures from the ceiling and at that moment curtains are closed. In the second scene (Figure 4.9) the lights are off but the curtains are open thus, the classroom is illuminated by sunlight coming inside. In the third scene (Figure 4.10.) both curtains are open and lights are on that provides illumination at the best possible level.

Figure 4.8: Artificial lighting (curtains closed, lamps on)

Source: 3D Render created with SketchUp+Vray version 2017 by the author

Figure 4.9: Natural lighting (curtains open, lights off)

Source: 3D Render created with SketchUp+Vray version 2017 by the author

Figure 4.10: Natural lighting + artificial lighting (curtains open, lamps on)

Source: 3D Render created with SketchUp+Vray version 2017 by the author

Children were supposed to mark the one that they would like to play or study in. This photograph rating was used as a measure of lighting preferences in generic place.

4.3.2.2. Teachers' Questionnaire

Teachers' questionnaire includes two parts with total 30 questions. There are 18 questions adapted from Prof. Dr. Eyüp Sabri Ercan's Attention Deficiencies Hyperactivity Disorder Measurement-Teacher and 12 commentary questions about sunlight, natural elements and general features effects on children's focusing and learning spaces.

Despite using the same test with Prof. Dr. Eyüp Sabri Ercan's, Likert type questions format has been rearranged by adding midpoint as 'undecided' option to give the respondent the right to abstain as well as to improve the reliability and validity of the results (O'Muircheartaigh et al. 1999).

4.4. Application

The application was conducted in one day and took two hours. 18 children and three teachers attended. First, the school was analyzed, and the appropriate classroom was chosen. The classroom choice is done according to it's having the best relation with sunlight. The chosen classroom had the best sunlight inside at 10:00 am in the morning. The application was performed at that time of the day in order to get the best results.

Initially, children were informed about the benefits of sunlight and the relation between sunlight and architectural space is explained to them. Children were numbered from one to 20 but two children did not attend that day's class, so child number 10 and 16 were not evaluated. 1/20 Model of the classroom was put on the table which was made by the thesis author was centered in the classroom in order to make all children see the model (Figure 4.11). All the materials were lined up on the table such as a mini lamp, white cubes, and windows.

Figure 4.11: Preparation of the application

Source: photography by the author

The application procedure is explained to the children and tested with one child in order to see as if it is clear in children's minds. The mini lamp used as sunlight and held inside the windows. Children saw how sunlight illuminated the classroom with certain size windows.

All the children were invited one by to the model set-up. Each child was asked to show their preferences on the model after trying the windows with a mini lamp in order to simulate the effects of sunlight coming inside. By the time the children answered questions about their preferences such as what was the effect of sunlight on their decision. The aim of this application was to find out the window size preferences of the children and note their comments and feelings about the light entering the class in relation to their focus and interest.

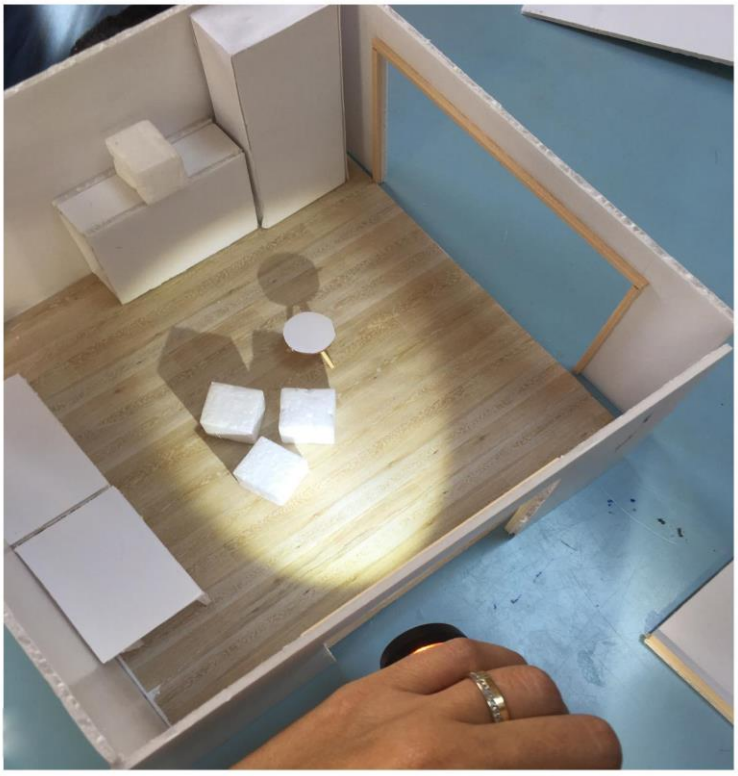

Figure 4.12: 1/20 scale model with big size window chosen

Source: Model and photography by the author

Figure 4.13: Re-designing the window sizes of the classroom through the model

Source: Model and photography by the author

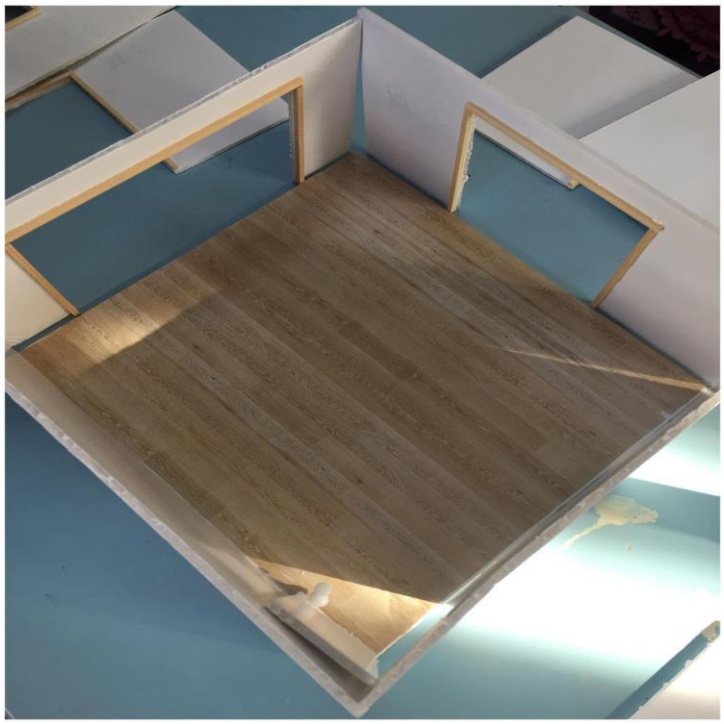

Figure 4.14: Both side walls with the biggest window choices

Source: Model and photography by the author

Figure 4.15: Materials of the study

Source: Model and photography by the author

After all, whole children were gathered around the table and designed their model classroom with white cubes as they wish to see it as shown in the Figure 4.16. They chose to put the seating elements near the big windows and stated that they feel more willing to play and learn if the space is luminous especially with sunlight.

Figure 4.16: Children designed their classroom altogether

Source: Model and photography by the author

Figure 4.17: Sitting elements are placed near the window by the children

Source: Model and photography by the author

Figure 4.18: Children's preferences on model

Source: Model and photography by the author

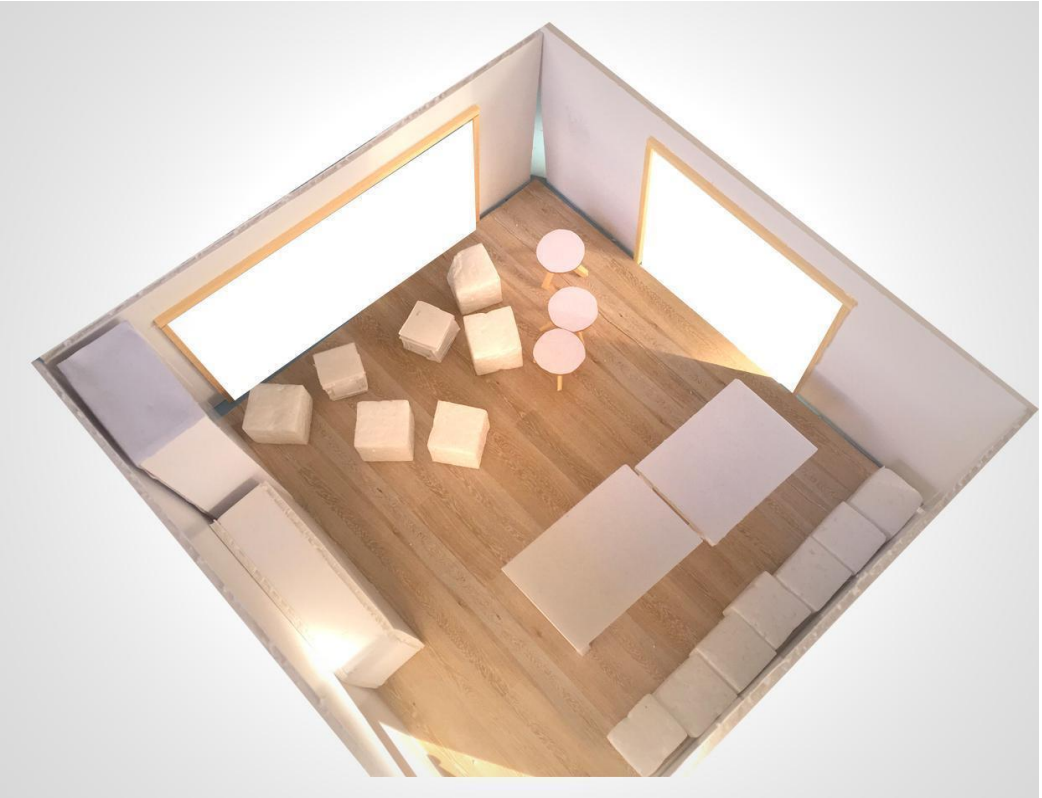

Figure 4.19: Classroom designed by the children

Source: Model and photography by the author

At that moment teachers were responding the teacher's questionnaire that consisted of two parts. After collecting the forms from teachers, children were also questioned with 3D scene preferences (Figures 4.8;9;10.). At the end of the study, small gifts for children and teachers were distributed with special thanks.

4.5. Findings and Discussion

Table 4.1. displays the three evaluation results together for comparison. The left column shows the numbers of the children. On the top, there are research tools such as model, render and questionnaire. Each child chose to a different window alternative for instead of both window-1 and window-2. According to results, it is clearly seen in table that which of the size is preferred over the others. Results of the model study show that in total, the smallest window was chosen 13 times, the middle sized was chosen four times and the biggest size was chosen 19 times by the children on model activity. While choosing their preferences about window sizes children said that light affects their playing enthusiasm. According to their answers, it is

obviously seen that, when it is sunny outside or sunlit inside it is a fun place for them to spend time in.

In the Table 4.1, there is render column which represents the children's questionnaire about choosing a 3D model classroom setting. N represents natural lighting, A represents artificial lighting, and NA represents natural lighting+artificial lighting. The figure also shows that some children answered inconsistently in model and render scene choices. For example, children number three and six chose a small window for both sides of the class in the model, whereas they both chose natural lighting+artificial lighting render setting in children's questionnaire preferences which may be related with focusing on different aspects.

	MODEL		RENDER	TEACHERS' QUESTIONNAIRE				
CHILD	WİNDOW-1	WİNDOW-2	SCENE	S. A	A	U	D	S. D
1	MIDDLE	SMALL	N					
2	SMALL	SMALL	A					
3	SMALL	SMALL	NA		4			
4	BIG	BIG	A					
5	MIDDLE	SMALL	N		2			
6	SMALL	SMALL	NA		5			
7	BIG	BIG	A		1			
8	BIG	SMALL	N	2	3			
9	BIG	BIG	NA					
11	BIG	BIG	A		1			
12	MIDDLE	SMALL	NA					
13	BIG	BIG	NA					
14	BIG	MIDDLE	NA					
15	BIG	SMALL	A		6			
17	BIG	BIG	A		1			
18	BIG	BIG	A					
19	BIG	BIG	N					
20	SMALL	SMALL	N					
	SMALL=13		A=7	S.A: STRONGLY AGREE				
	MIDDLE=4		N=5	A: AGREE				
	BIG=19		NA=6	U: UNDECIDED				
TOTAL	18 CHILDREN		18 CHILDREN	D: DISAGREE				
	36 CHOICE		18 CHOICE	S.D: STRONGLY DISAGREE				

Table 4.1: Results of model, render, and teachers' questionnaire.

Source: Table by the author

There are no diagnosed children with ADHD in this study, but there are children who are likely to have the symptoms according to teachers' questionnaire (Table 4.1). According to Ercan's Scale, the results of this questionnaire is evaluated through the numbers of symptoms. If a child has more than five marks, has a probability of having ADHD. However, this scale cannot be used to diagnose, it is only a supportive tool. Children number six and 15 got more than 5 marks and also they choose smaller windows in the study. Indeed, sunlight is a definite advantage for children thus it may be positive for also these children who may have ADHD symptoms.

Model Results

WINDOW CHOICE	NUMBER OF CHILDREN
Big size	19
Medium size	4
Small size	13

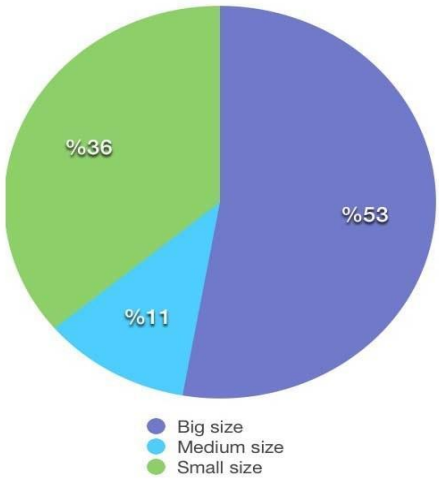

Table 4.2: Graph of model results

Source: Pie chart by the author

Artificial lighting got the highest score in children's questionnaire (Table 4.3) results. But in total natural lighting choice and natural lighting+artificial lighting choice have more percentage in total. The reason why artificial lighting is preferred over the others in the results may be due to having a more controlled and calm background. Nature has positive effects on children but may also cause complexity in specific situations.

Children's Questionnaire Through 3D Render

ILLUMINATION CHOICE	NUMBER OF CHILDREN
Artificial lighting	7
Natural lighting	5
Natural lighting + artificial lighting	6

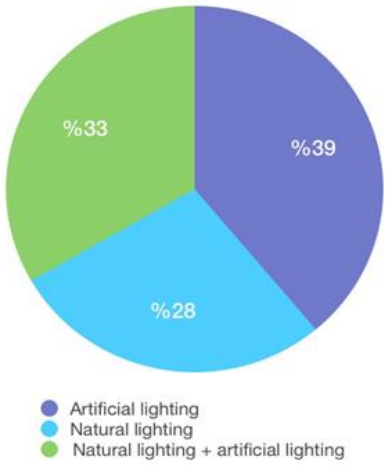

Table 4.3: Graph of children's questionnaire results

Source: Pie chart by the author

Teacher's Questionnaire Results

Sunlight	Positive effects / more active / more conscious / willing to learn / focus faster / controlled sunlight
Natural elements	Natural elements make children calmer / contibute focus
General features	Organization of the furniture / ergonomics / airy and luminious / noise and darkness control

Table 4.4: Graph of teacher's questionnaire results

Source: Table by the author

Teacher's questionnaire (Table 4.4) about sunlight, natural elements, and general features summarizes that sunlight has positive effects on children as they become more active in lessons if the classroom gets sunlight inside at desired levels. The more the sunlight is controlled, the more spacious the environment feels. Children become more conscious and willing to learn in sunlit spaces as teachers reported. One teacher stated that children focus faster in bright environments whereas another one said controlled sunlight is better. One teacher said during the activities that require material such as literacy teachers they need more sunlight inside whereas the other teacher said during play activities they need more because children learn while playing. The classroom gets the ideal sunlight from 10:00 to 12:00, as the teachers expressed so they try to use these hours more intentionally. Natural elements said by teachers to make children calmer and more focused because it is more exciting for kids to be outdoors in general. Besides, they are more vibrant and energetic. They are motivated by the differences they see and they are starting a new lesson with more focus and concentration.

When activities require long-term attention teachers said that they organize the furniture according to the activity and we aim to make children comfortable during the activity. Sometimes it gets tiring to sit on the floor so if it takes longer we use the chairs. They open the curtains and prepare an airy and luminous class and provide silence if necessary for the activity. Noise is distracting, darkness causes sluggishness. According to teachers, in the physical conditions of their school, there can be some small differences to contribute children's both academic and psychological development such as arranging the classes larger and more flexible and providing various options for light and sound.

CHAPTER 5

CONCLUSION

This study investigated the role of the sunlight on preschool children's focus. The case study was conducted with 18 children and their three teachers. Preschool children were asked to choose their ideal classroom from the same settings with different lighting scenes prepared with SketchUp+Vray version 2017. Additionally, children were questioned through their classroom's scale model about their preferences from different size window options and desired sunlight levels. Lastly, children's teachers answered a questionnaire about the relationship between sunlight and learning environments.

According to the findings of this study, sunlight affects children in a positive way and the interiors designed in accordance with this information contribute to the improvement of the preschool children and their learning environments. As a conclusion, it can be clarified that interior architectural interventions such as wide size windows or skylights which allow interiors to get controlled sunlight can contribute children's focus and learning environments.

5.1. Design Proposals

This study aims to make a contribution to the improvement of the preschool learning environments design for better performance. Guidelines to assist interior architects, designers, and school administrators are listed hereinafter.

- Biophilic design elements should be taken into consideration while designing children's environments such as bringing sunlight inside the space or providing natural view like trees or grass as the children become more focused and willing.

- Larger windows provide positive effect on children's enthusiasm and performance.

- Controlled sunlight, combined with appropriate artificial lighting when needed, provides students with the best lighting conditions. Glare problems and visual discomfort should be avoided with the help of suitable shading devices.

- Associating indoors with outdoors affect the amount and quality of physical activity of children and contribute their experiencing the reality and focus.

-Sunlight should be arranged to enter the space from more than one direction in order to block high contrasts which makes the eyes work too hard to identify and complete tasks.

- Situating seatings close to the windows help children concentrate better on their play and learning.

Other suggestions might include:

- Poor air quality causes difficulty in concentrating, thus air quality, temperature, lighting, and acoustics are important points while designing children's environments (Baker and Bernstein, 2012).

- Situating the building on east and west axis provide abundant sunlight and have a low risk of glare. South-facing windows, roof monitors, and skylights provide maximum sunlight in. However, glare and thermal control, balanced brightness, and higher reflectance ratings should be taken under countenance. For example, expansive glazing should be avoided when it is orientated South and if applied, in order to control sunlight penetration external shadings should be provided. Moreover, abundant and high-quality electrical lighting is essential to provide a reasonable visual environment in interiors (Barrett et al., 2015).

- While designing children for especially who are with special conditions like ADHD, interiors should have clear plans because complexity creates stress for children with ADHD. Furniture affects children as well as other distractions like walls, board etc. Simple color gradation connecting the color of the walls, floor, and ceiling facilitates self-control, provides a sense of security and greater calm in the space, increases concentration, and eliminates distractions (Alkahtany, 2014).

5.2. Limitations

One of the limitations of the study was that firstly, this study wanted to be actualized with both children with or without ADHD at the same time in order to benefit all children. Unfortunately, it was not possible to reach children diagnosed with ADHD. Although the prevalence of ADHD is very high especially in children In Turkey, there are plenty of foundations about ADHD. That shows this disorder does not seem to be a serious situation affecting patients' life quality according to authorities. Communication with these children is only monopolized by psychologists and psychiatrists. It is observed that there is a need for a social support for children with ADHD and their families. Another limitation was about permissions from the schools and government. The procedure was too long and no permission was given for any applications in public schools and colleges depending on government's decision thus the study was conducted in a private preschool with a low number of children.

5.3. Further Studies

In a further version of the study, the number of participants could be increased and, participants with diverse conditions could be involved to increase the reliability of the results. The complexity of outdoor space was a variable in children's questionnaire 3D classroom preference. Even though it is only one space, the exterior and interior spaces expand broadly perceptually. In this study, nature is distracting when it comes to class, but maybe it could give different results in other environments. Detailed results can be obtained if all these factors are taken under control.

This study aims to light up the role of sunlight on preschool children's focus and intends to make a contribution to the improvement of the preschool learning environments. In academic context, contribution to learning environments both in theory and practice by supporting practitioners like designers and educators is sought out.

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APPENDICES

APPENDIX A: Questionnaire for Children

İZMİR UNIVERSITY OF ECONOMICS

THE ROLE OF SUNLIGHT ON PRESCHOOL LEARNING ENVIRONMENTS

This research was carried out within the scope of Izmir University of Economics Graduate School of Social Sciences, as a dissertation for the Master's Degree Program of Design Studies (MSc), conducted under the consultancy of Assoc. Prof. Dr. Deniz Hasırcı. The study aims to analyze the role of the sunlight on preschool children's focus and intends to make a contribution to the improvement of preschool learning environments with interior design proposals. The information obtained will be used for academic purposes, and your institution will be informed about the results. It is very important in terms of scientific validity and reliability of the research to answer the questions below in the way that is most appropriate to you. Thank you for your invaluable contribution to this research.

Researcher, Thesis owner
İklime Polat Yalçıner

Artificial Lighting

Natural Lighting

Natural Lighting
+
Artificial Lighting

APPENDIX B: Questionnaire for Teachers

İZMİR UNIVERSITY OF ECONOMICS

THE ROLE OF SUNLIGHT ON PRESCHOOL LEARNING ENVIRONMENTS

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Researcher, Thesis owner
İklime Polat Yalçıner

Please rate the degree to which you agree or disagree with each of the following statements. (1: I strongly agree / 2: I agree / 3: Don't know/No opinion 4: I do not agree / 5: I strongly disagree)

1- He can not give attention to details or he makes careless mistakes in other activities.

1	2	3	4	5

2- He finds it difficult to keep his focus on the tasks while playing or carrying out a task.

1	2	3	4	5

3- He does not seem to be listening when he is addressed directly.

1	2	3	4	5

4- He does not monitor directives as required and can not usually complete school assignments or small jobs.

1	2	3	4	5

5- He has difficulty in organizing tasks and activities.

1	2	3	4	5

6- He avoids tasks that require long-term focus (such as school work or homework).

1	2	3	4	5

7- He loses the items (pen, book etc.) required for the task or activities.

1	2	3	4	5

8- He loses attention easily.

1	2	3	4	5

9- He is forgetful of daily activities.

1	2	3	4	5

10- His hands and feet are always moving/fidgeting.

1	2	3	4	5

11- He can not sit on the bench or in other situations where he should sit.

1	2	3	4	5

12- He bats around in inappropriate situations.

1	2	3	4	5

13- He has difficulty playing calmly or participating in leisure activities.

1	2	3	4	5

14- He's always on the move.

1	2	3	4	5

15- He talks a lot.

1	2	3	4	5

16- He responses while the question is being asked.

1	2	3	4	5

17- He has difficulty waiting for his turn.

1	2	3	4	5

18- He interrupts others or intrudes into the speeches or games of others.

1	2	3	4	5

Thank you for your valuable opinion!

Reference

Prof. Dr. Eyüp Sabri Ercan Dikkat Testi kullanılmıştır (www.eyupsabriercan.com)

İZMİR UNIVERSITY OF ECONOMICS

THE ROLE OF SUNLIGHT ON PRESCHOOL LEARNING ENVIRONMENTS

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Researcher, Thesis owner
İklime Polat Yalçıner

Sunlight

1- In what ways do you think sunlight affects children's success?

2- What type of light helps children focus faster and have a longer attention span?

3- During which activities do you try to get maximum benefit from sunlight and why?

4- What period of a day or during what hours does your school get the most qualified and adequate sunlight? Do you intentionally try to utilize that time frame by doing specific activities?

Natural Elements

1- How do you think natural elements affect children's focus and calmness in the classroom?

2- What types of behavior do children present while they are in an interior space in relation to outdoors?

3- How does the time spent in the places with natural elements like trees or soil affect children's focus in the following lesson?

4- Could you evaluate your school's classrooms in regards to their connection to nature?

General Features

1- What kind of spatial features do you intend to offer children when during activities that require long-term attention?

2- What are the effects of the environment on children's attention in details?

3- What qualifications of the environment are needed to maintain children's attention and focus on the task?

4- What changes in the physical conditions of your school would make a difference in the academic and psychological development of the students?

Thank you for your valuable opinion!