Summer 8-2014

Impacts of Daylighting on Preschool Students' Social and Cognitive Skills

Safak Yacan
University of Nebraska-Lincoln, safakdincer@gmail.com

Follow this and additional works at: http://digitalcommons.unl.edu/arch_id_theses
Part of the Elementary and Middle and Secondary Education Administration Commons, Environmental Design Commons, and the Other Education Commons


This Article is brought to you for free and open access by the Interior Design Program at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Interior Design Program: Theses by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.
IMPACTS OF DAYLIGHTING ON PRESCHOOL STUDENTS’ SOCIAL AND COGNITIVE SKILLS

By

Safak Dincer Yacan

A THESIS

Presented to the Faculty of
The Graduate College at the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Master of Science

Major: Architecture
Under the Supervision of Professor Mark Hinchman
Lincoln, Nebraska
August, 2014
The focus of this study is the element of daylight in preschools and its social and cognitive effects on preschoolers. The current study is a correlational study that assesses infants’ social and cognitive developments, and daylight in preschool classrooms. Participants were 69 children (30 boys and 39 girls), aged from four to five, who enrolled in two different early childhood facilities in Van in Turkey. It was hypothesized that preschoolers’ social and cognitive skills would be correlated with daylight in preschool classrooms. Results revealed that there was a crucial correlation between preschool students’ social behavior and cognitive skills and daylight in preschool classrooms. It was also hypothesized that there would be a correlation between classrooms’ daylight conditions and students’ social competence in preschools. The results showed that there was a significant correlation between students’ social behaviors and preschools’ classrooms daylight conditions. Furthermore, students’ cognitive skills were also crucially correlated with classrooms’ daylight conditions in preschools. However, there was not an association between boys and girls regarding social behavior and cognitive skills. Additionally, children’s social competences and cognitive behaviors did not
significantly differ by age. Also, limitations of the current study and further considerations are discussed.
ACKNOWLEDGEMENTS

I offer my sincerest thanks to my advisor, Professor Mark Hinchman, who gave me his feedback in all phases of this process along with his support and guidance during my thesis and throughout my graduate coursework. His insight was invaluable and his help greatly valued. I also would like to thank the members of my master’s committee, Prof. Betsy Gabb and Dr. Lindsey Ellsworth-Bahe who shared their professional expertise and experience to make this thesis possible.

Special thanks to Ibrahim Hakki Acar, one of my best friends and also a graduate research assistant at Child Youth and Family Studies at University of Nebraska-Lincoln, who provided insight and support for the development of the project from data collection and to the thorough analysis and interpretation stages.

I would like to thank my family and friends who are an endless form of support. Their encouraging words, offering insight and sharing experiences have made my graduate study possible. And my husband, my biggest supporter and encourager, thank you for providing a solid emotional foundation.
DEDICATION

To my loving husband Caner

To my wonderful family
# TABLE OF CONTENTS

ABSTRACT ................................................................................................................................. ii
ACKNOWLEDGEMENTS ............................................................................................................... iii
DEDICATION ................................................................................................................................. iv
TABLE OF CONTENTS ................................................................................................................... v
INTRODUCTION ............................................................................................................................... 1

Chapter I:
Statement of The Problem (Background) .................................................................................... 4
Research Questions ....................................................................................................................... 5
Significance of the Questions ........................................................................................................ 6

Chapter II: Literature Review ....................................................................................................... 9
Definition of Daylight .................................................................................................................... 10
History of Lighting on Schools ..................................................................................................... 10
School Building (Prior to 1930) ................................................................................................. 10
The Progressive Era (1930-1945) ............................................................................................. 12
Post War Boom (1945-1960) ...................................................................................................... 13
The Impulsive Period (1960-1980) ........................................................................................... 13
Declines of the 1980’s and the New Moments of the 1990’s and 2000’s ..................... 14
Development Theories ................................................................................................................ 15
Learning Strategy ....................................................................................................................... 18
The Design of Daylighting .......................................................................................................... 19
Benefits of Daylighting ................................................................................................................ 22
Turkish Schools ............................................................................................................................ 25

Chapter III: Methodology .......................................................................................................... 32
Overview ......................................................................................................................................... 32
Participants ...................................................................................................................................... 32
Measures ......................................................................................................................................... 32
Social Behavior ............................................................................................................................ 32
Cognitive Development ............................................................................................................... 33
Data Collection Procedures ........................................................................................................ 34

Chapter IV: Results ..................................................................................................................... 36
Data Analyses ............................................................................................................................... 36
Preliminary Analyses ................................................................................................................... 36
Research Question 1 .................................................................................................................... 36
Research Question 2 .................................................................................................................... 37

Chapter V: Discussion .................................................................................................................. 38
Further Considerations and Limitations ..................................................................................... 39

References ...................................................................................................................................... 40

Tables
Table 1: Participant’s Demographic Information .......................................................................... 44
Table 2: Descriptive Statistics of Variables ................................................................................... 45
Table 3: Correlations among Social Competence, Cognitive Skills, Gender and Age.................................................................................................................................46

Appendices
Appendix A: Complete Demographic Information........................................................................47
Appendix B: School Social Behavior Scale..................................................................................48
Appendix C: Marmara Development Scale................................................................................51
Appendix D: Letter of Information and Informed Consent.........................................................54
INTRODUCTION

The built environment has a remarkable role in people’s lives. A knowledge, which is formulated from with multiple life practices, shows that the human has a unique and complex mind. According to results of environmental psychologists’ research, people are influenced by aspects of their surroundings. In this context, green structures have made their way into the design and architecture professions, and also have become a powerful target of study and practice. Many reasons make the concept of green building popular and the environmental benefits may be the most frequent reason for eco-buildings. Interior design includes many interdependent elements, which include space, form, structure, lighting, texture and color.

In this study, the one interior design element, lighting, is examined at depth within the context of preschool design. Daylight is the primary light source which, aside from being indispensable, has the potential to create cozy and comfortable interior environments. Daylighting is a free natural resource, which allows buildings to develop physical and psychological reactions. Equally important natural light is a renewable resource. Adequate daylighting has been demonstrated to make environments healthier (Zaharim, Azami and Kamaruzzaman, Sopian. Computational Methods in Science & Engineering. WSEAS Press: 2013). Various research projects have already displayed that student performance increases when their classrooms enjoy natural light (Demir, Ayse. “Impact of Daylighting on Student and Teacher Performance.” Journal of Educational Instructional Studies in the World 3, no.1 (2013): 1-7). Skylight generally provides a
simple illustration function that overhead horizontal openings allow light to enter but they do not allow inhabitants to view the exterior landscape, whereas windows have a far more complex effect on people. It has been postulated that by including educational facilities with skylights rather than natural lighting from windows, we could better separate the effects of daylight. Skylight usually gives a simple illuminating function, whereas windows may have a far a complex effect on people. Furthermore, in what ways do students react and how do habits develop in these planned spaces? Daylighting will also vary from one school building to another, depending on building orientation, site, climate and latitude, so that cookie-cutter building design will rarely provide ideal lighting. In the Northern Hemisphere, this can turn south facing walls into a great source of indirect light. Relating to the orientation of the rooms the “windows direction” is determined and resulting in effects of direct sunlight and daylight. The design professionals must provide extraordinary design leadership through the use of natural daylighting and daylight modeling. The use of research for health and productivity benefits of natural daylight and daylighting modeling must be considered.

The dynamic nature of daylight together with the wide range of intensities and distribution, demands a sophisticated understanding of its interactions with a building and buildings. Kuller and Lindsten in 1992 studied children’s health and behaviors in classrooms with and without windows for an entire academic year. They concluded that work in classrooms without windows affected the basic pattern of the hormone cortisol, which is associated with stress, and could therefore have a negative effect on children’s health and concentration. Another study in Sweden found that observed behavior and circadian hormone levels of elementary students in classrooms with daylight stayed
closer to expected models than those in classrooms with only fluorescent sources. The Swedish researchers concluded that windowless classrooms should be avoided. The built environment plays a large role in the everyday life of humans as we live, work, shop and play in and around a man-made structure. Eco-building educational facilities appear to provide an environment which pupils and teachers both value, and this finds expression in a number of external measures.
CHAPTER I

I. Statement of the Problem (Background)

If traditional schools are compared with sustainable schools, green schools provide more environmental, economic and social benefits for their occupants. When looking at the social benefits of sustainable schools, one notices that they develop students’ comfort and health, enhance aesthetic qualities in spaces, and improve test scores of students and overall quality of preschoolers’ lives. Schools have responsibilities for making individual learning easier, solving problems and fostering practical and creative skills, traditional schools are being designed for educating students uniformly and graduating them with a minimum outcome of education as a baseline. Furthermore, green schools contribute to a sustainable life for students with their buildings and daily teaching practices preparing them for their future lives. Sustainable schools, which are designed to enrich their environment and that of their students, help to enhance students’ test scores and teachers’ performance, reduce operating costs, provide healthy spaces for students enabling them to reach natural lighting, indoor air quality, acoustic, comfort and clean air and also, protect their environments (Gokmen, H.Sivri. “Environmental Architecture: A Look at The Sustainable School Examples.” Mimarlik 368 (2012): 53-58.) But unfortunately, many schools built in traditional styles in undeveloped countries and the facilities don’t include any elements of sustainable design in the buildings. Turkey is one of them and students are affected by negative impacts of the buildings. The Turkish Ministry of Education has not instituted a program of incorporating sustainability into its educational facilities. Especially many public schools in Turkey are deprived of appropriate
daylighting, which is one of the elements of sustainable design, and one that has a direct outcome on student learning. Many researchers proved that schools, which have incorporated daylighting systems into their design, are helpful to students’ learning (Pulay, 2010).

II. Research Questions

The main question under the investigation of this study is to identify how students are affected by the impact of daylighting in preschool/early childhood educational facilities. In order to answer the question properly, first of all, we need to respond several sub-questions.

Above all, one of the most significant questions is what does daylight mean? This question helps us to identify the key word of the study and gives some general information.

Another remarkable sub-question centers on the correlation between natural light and learning environment, and why we should provide daylight in schools. These two questions are significant since they will lead us to find the main idea about the study. Thus, the importance of daylight in preschools will be discovered and emphasized by the current study.

The next notable question concerns what the goals for providing good daylighting in the classrooms of preschools are. The question gives some advantages to highlight a point that not only is daylight necessary in classrooms but also the quality of the daylighting is to be considered in order to understand the benefits for students.

Additionally, another sub-question is: how does daylight integrate with overall child development? This question is directly connected to the main question and provides
opportunities to reach the main idea of the study and discover the positive or negative
effects daylight has on child development.

Last but not least, how should designers/architects create appropriate and good
quality natural light in early childhood facilities? This question is striking because it
helps to determine which kinds of design strategies should be used to provide appropriate
and sufficient daylight in classrooms.

III. Significance of the Questions

My research question is significant because preschool students are in a developmental
age and they spend most part of the day involved in educational facilities. Thus, the
design of the schools can have a direct effect on students’ performances in class, as well
as achievements in the activities and participations in the classes (Pulay, Alana S. “
Awareness of Daylighting on Student Learning in an Educational Facility.” Master’s
Thesis, University of Nebraska-Lincoln, 2010.). Additionally, Demir claims that the
effect of daylighting on circadian rhythms can affect productivity as well as health.
According to the Green School Initiative (Global Green USA, 2005) daylight provides
biological stimulation that regulates body systems and mood, saves costs, and offers the
benefits of natural ventilation (Demir, Ayse. “Impact of Daylighting on Student and
Teacher Performance.” Journal of Educational Instructional Studies in the World 3, no.1
(2013):1-7.) In these contexts, daylight which is an important component of sustainable
design, comes into prominence in preschool design in terms of its impacts on children
attainment. All in all, a proper early childhood facility is a place where pupils can have
ample natural light in classrooms (Anita Rui Olds, Child Care Design Guide, (New York,
McGraw-Hill, 2001), 187-196). The benefits of lighting on students’ learning are only
effective when the lighting in a classroom is planned efficiently (Pulay, Alana S. “Awareness of Daylighting on Student Learning in an Educational Facility.” Master’s Thesis, University of Nebraska-Lincoln, 2010.). That means that not only daylight is a requirement for school design but also, it should be provided for appropriately. When we consider daylighting in schools of Turkey’s public school scale, the Republic of Turkey Ministry of Education has a few types of school models and they implement only these models in every city without taking into consideration the weather, direction of lands, etc. When observed, it can easily be seen that the some of the schools are not built with consideration of daylight effects, especially regarding building orientation. While some classes have daylight during the day, others are deprived of natural light all day long. Also, another problem is that even when daylight enters into a classroom at some point during the day, the building is not able to have a design that provides appropriate and sufficient quality daylight in the classrooms. In this case, through this research readers will have a better understanding of how daylight in learning environments for preschool aged children should be used. These research ideas and concepts could influence the architecture and design department at the Ministry of Education of Turkey to reconsider construction and building requirements that combine with more sustainable design teaching techniques.
Figure 1 - The effect of lighting on human performance and health through the visual and circadian systems


Figure 2 - What is light?

CHAPTER II - LITERATURE REVIEW

The review of literature begins by exploring the definition of daylight and history of daylighting schools. Following that, development theories and learning strategies are reviewed. The design of daylighting and Turkish school design and daylighting in Turkish schools are also summarized.

The intent of this study is to investigate the impact of daylight in the classroom on students at preschools. Today, many schools, which are called “traditional schools”, are established without considering whether the learning environments include sufficient daylight or not. Numerous sources have found that daylight impacts student performance in preschool classrooms; this knowledge results in schools designed from the start to consider the importance of daylight and its impacts. Some research demonstrates that student behavior and learning can be affected by physical environment (Cornell, 2002; Veltri, Banning and Davies, 2006; Tanner, 2008). In this regard, the architecture of the classroom describes the physical environment.

The architecture consists of room size, form, height, furnishing, windows, doors and lighting. According to Veltri, Banning and Davies (2006), the physical environment in classrooms can affect pupils’ behaviors as well as their attending school. Besides that, Cornell (2002) mentions that classrooms have some inviting characteristics to persuade students to be there and in that case, physical environment is a key to affect users with school building’s quality in a good way.
I. WHAT IS DAYLIGHT?

The term daylight can be defined as a natural light in space, which is coming into the space through windows and skylights, in contrast to artificial lights in a room. The terms daylighting and natural lighting can be used as synonymous words (Pulay, 2010).

II. HISTORY OF LIGHTING ON SCHOOL DESIGNS

School building (Prior to 1930)

One of the crucial attitudes of earlier school buildings was basically daylighting, because of the inadequacy of artificial lighting available. Buildings of educational facilities were meticulously designed and placed to provide benefits of the best daylighting qualities, and these were meticulously proved and profoundly perceived by architects and designers in that period. Truly, architects at that time acquired more particular concepts of sufficient natural lighting than today’s architects do now. According to Hamlin (1910), one of the researchers have found out that “Light ought to come over each student’s left shoulder. That means students should be right handed and when the light comes over student’s right shoulder, the light would be closed through their arms. Figure 3 demonstrates how to illuminate classrooms, besides the significance of preventing dark spots from window is highlighted.
In this period, standards of daylighting were quite normative like definite window areas and the ratios of window to floor area. These kinds of classrooms at schools, which were standardized by these rules, are still in use today.
**The Progressive Era (1930-1945)**

According to Weisser (2006), to combat against depression, a good number of educational facilities were built in the 1930’s due to the economic contribution to the Public Works Administration, which covered 70 percent of the construction of new schools for local communities. During the 1930’s and 1940’s, most educational facilities in the US were designed by means of metrics and design features of earlier periods, even though newer models for educational facilities became popular. Moreover, such new innovators as Maria Montessori from Italy and John Dewey from the U.S. emerged from schools by the leadership at some models. As Hille said in 2011, these leaders promoted the opinion of child-centered learning and improved scholarly methods, which have built the basis of today’s educational ideas. In the 1920’s and 1930’s, an alternative wave of progressive schools emerged and many of these significant educational facilities were built by modernist architects of those days such as Saarinen, Aalto, and Neutra. Their schools started the open-air school movement. These buildings were called “open-air school” since in their design, air, light, outdoor learning and easy circulation became important notions. Since architects designing these schools highlighted the significance of natural air, outdoor activity and physical health as principles of psychological well-being, the schools were termed “functionalist” by Hille. In the 1930’s also the matter of the psychological influences of school buildings were on the increase in terms of their importance and thus open plan school designs were concentrating generally on the significance of child care design.
Post War Boom (1945-1960)

In 1949, a special issue dedicated to the design of educational facilities appeared which had articles about acoustic, lighting, heating, ventilation and many more elements of school design. Throughout 1940’s and 1950’s, the evolution of economical fluorescent lighting was providing advances with artificially light in educational areas rather than sunlight, which is coming from windows. It was a notable time about how to illuminate classrooms because lighting standards and perspectives were changing for educational areas. As Building Research Institute mentioned in 1959, some people, who were working for the Illuminating Engineering Society’s research arm, made some tests to determine new light level standards and then they decided to increase the classroom’s lighting standards from 30 foot-candles to 70 foot-candles.

The “Impulsive” Period (1960-1980)

Not only heating and ventilation were crucial issues about school design, which provided energy saving, but also lighting was one of the most significant fields of energy conservation. End of the 1960’s, Castaldi said that, “Recently, the emphasis has shifted from natural to artificial illumination, which no longer fixes the width of any space in which adequate lighting.” The NCSC as cited by Baker believed this movement and mentioned that the most common sources of excessive brightness are the sky, natural sunlight from windows, and the bright wall areas of a contiguous building.

In this time, windowless classrooms became a current issue as an option. According to Weinstein’s reviews, some studies in the beginning of the 1970’s, demonstrated that the classrooms which did not have any windows, had no noticeable bad

---

1 Basil Castaldi, Creative Planning of Educational Facilities (Chicago, IL: Rand McNally Co., 1969), 194.
effects on children learning, even though the educators and children were dissatisfied about their undesirable quality. However, dissatisfaction of users was not effective on architects of the time to change this idea, and it became popular during 1970’s. Curiously, Weinstein, who is an educational researcher, stated that windowless classrooms are a modernization for architecture about school design. Even though today some architects and researchers have thought that the idea of windowless classroom was a part of educational theory, most evidence proved in that era, it was a distinct architectural preference.

At the same time, McGuffey (1982) mentioned that there was no important difference about children’s performance in windowless classrooms. Also, he reexamined underground schools, which were suggested by the Department of Defense to also provide fallout shelters. But, the results of the reexamination did not include any thing about the effect on student performance, anxiety levels, behavior and mood. Contrary to this, earlier writings were insisting on the significance of outdoors, and according to current research, windowless classrooms cause a distinct decrease in student health and well-being.

**Declines of the 1980 and the New Movements of the 1990’s and 2000’s**

In recent years, even though lighting standards are mostly determined, there are still some conflicts about how much lighting should be provided to classrooms. For instance, although the ASHRAE Advanced Energy Design Guide is reinforced by IESNA (Illuminating Engineering Society of North America), the ASHRAE’s guide supports 30-70 foot-candles for classrooms, IESNA prefer 50-100 foot-candles for classrooms today (Baker, 2012). Besides that some concerns about quality and distribution of light and
other specific issues in daylighting design dwarf these kinds of conflicts. Today’s researchers are concentrating on performance-based standards like illumination and visual comfort metrics.

After natural lighting came into prominence, studies on illumination in classrooms in the past two decades has also gained significant influence on practice. An example of this: one research examined cortisol (a hormone) production and concentration abilities in children without access to sunlight, and discovered there is a positive correlation between natural light and the cortisol hormone (Kuller and Lindsten, 1992).

A study was published about daylighting in classrooms by the Heschong Mahone Group in 1999 and the research supports the idea about that there can be a positive correlation between school buildings and students’ learning (Heschong and Mahone, 1999).

Lately, studies on the importance of daylighting increases and many schools have been built with sufficient natural light criteria, but there is less attention to problems of visual comfort and glare.

III. DEVELOPMENT THEORIES

Studies have proven that learning and development can be categorized at three different stages, which are physical development, cognitive development and socio-emotional development. Physical development includes motor skills and issues which are related to health (Taner, 1990); cognitive development is defined as how people’s minds and psychological process are working (Byrnes, 2001); and socio-emotional development states developments of people’s relationships, their concepts of themselves and their
emotions (Erikson, 1963). Surely, the physical environment greatly impacts developmental results, which are involving academic attainments, cognitive, social and emotional developments as well as their parents’ behaviors (Evans, 2006). Even though all three levels of student development are significant, this research concentrates on cognitive and social development.

People generally start to be interested in the topic of how physical environment impacts people’s behaviors, made clear in Winston Churchill’s famous quote: “We shape our buildings and then they shape us” (Bartels, Erica. “Transparency: The Unspoken Design Element-How Levels of Visibility Affect Adult Learning and Sharing.” Master’s Thesis, University of Nebraska-Lincoln, 2013). In recent years, educators, architects and researchers reveal that classroom design influences children’s behavior significantly. Moore mentioned that an environment’s design quality is connected to cognitive, social and emotional development. A place which includes architecturally well-defined activity settings is mostly connected to more cognitive and social activities (Moore, 1986). Gary Evans, an environmental and developmental psychologist at Cornell University, found that physical environment is effective on children’s development as psychosocial qualifications like communication with family and peers. Many factors impact student learning, which are noise level, classroom design aspects, economic concerns, daytime, scheduling, sleeping time or sleeplessness, and other similar problems. Controlling some of these is not possible many times, which includes scheduling, economic concerns, the hour of the day, etc., however according to Ehyl (as cited by Pulay), the architectural design in classroom can be improved to promote student’s learning.
Additionally, the reason of feeling worse in winter is largely related to light-related variables, like short day length and grey cloudy weather. There might be a correlation between bright light and people’s mood positively. The research of Aan Het Rot, Moskowitz and Young analyzed relations between bright light exposure and social interaction as using naturalistic information and found out that spending more time outside and promoting inside lighting might contribute to social behavior and mood with providing mild seasonality.

The ideas is believed that design element of physical surroundings of preschools have significant influences on infant’s behavior (Moore, 1987; Weinstein, 1987’ Wohlwil & Heft, 1987). Gibsons’s Ecological Theory of Visual Perception in 1986 showed that data, which is afforded through the environment for children is complex and abundant. Innately, infants are active observers, concentrate on discovering, gaining knowledge, recognizing, and distinguishing the differences of objects within their surroundings. Thus, environments are described through affordances, mentioned what habitat giving, providing, supplying or allowing infants that are understood and learned. Gibson’s theoretical ideas focused on how a physical surrounding would impact infant’s behavior, who is at preschool age, especially about cooperative behavior. In 1980’s and 1990’s, prosocial behavior development in infants has become popular in child development (Eisenberg & Mussen, 1989; Grusec & Lytton, 1988). Prosocial behavior is described as actions which help and advance another individual. Besides that, Goffin (1987) defined cooperative behavior as actions in which collaboration of two or more people reach an aim and is also defined as a principal part of prosocial behavior. According to Hay (1979)
and Honig (1984), when children are at a young age, they cooperate with each other and their cooperative abilities are improved throughout the kindergarten ages.

Heschong et al. (2002) claimed that daylight in classroom promotes student test score by up to 20 percent. A firm in North Carolina in the U.S. reported that in daylit schools children test results are higher than children’s test result in non-daylit schools. Because of the methodological limitations, these researches only have suggested that daylight have a consistently positive influence on students’ performance.

Earthman (1996) stated that student performance can be examined in two aspects, which are student achievement and student behavior. According to Earthman, childhood success is going to impact children’s behavior, and contrary, that children’s behavior is going to influence children’s success. Earthman (1996) asserted that if the physical environment impacts children behavior, it will directly impact children attainments, too. His research reviewed the correlation between buildings of educational facilities, childhood success and childhood behavior and he found out that there are some strong relationships between specific physical aspects and children’s performance.

**IV. LEARNING STRATEGIES**

Researches have shown that each person has a different learning ability, but the one common aspect is that people are learning during all their lives. The human brain has a complex structure that has been examined for periods, going a long way back to the second half of the nineteenth century while scientific methods were used to get data about the human mind. Thus far, philosophy and theology had been the incentives in the shade of the study. Recently, opinion is called science as cognitive science combines learning study with the majors of anthropology, linguistics, developmental psychology, computer
science, neuroscience, philosophy, and several branches of psychology for a combination of many disciplines. Fielding mentioned in 2006 that people learn best when they feel themselves in a safe, secure, cozy and challenged space.

According to Bransford (2000), the significance of learning can be explained with recognizing and the qualification of transfer data and apply it to other contexts. This concept supports that people start to gain information with pre-existing abilities, beliefs and notions that impact what people recognize about the surrounding and how they regulate and clarify it (Bransford, 2000).

V. THE DESIGN OF DAYLIGHTING

Some research showed the evidence that student learning is developed by incorporating daylighting methods into the design of educational facilities. But incorporating these is possible only on a carefully designed building that augments different types of illumination. This involves overhead indirect/direct fluorescent lights, electric bulbs and natural lighting (The Collaborative for High Performance Schools, 2002). Roof monitors, clerestories, diffusing baffles, blinds and blind controls, light shelves, light sensors, user-friendly dimming controls and fluorescent backup fixtures, occupancy controls, external shades, teacher and staff training and maintenance are used as daylight design components (Kennedy, 2005).

Exterior light shelf is an influential method in daylight design that blocks direct sunlight into the room by reflecting the sunlight into the space (Innovative Design, 2004). Before allowing the sunlight to enter the inside, reflecting the rays of the sun from a surface decreases the bad effects of the light and helps to decrease glare while reducing solar heat (Hampton, 2010). To provide effective light shelves, they should be used with
10-foot ceilings to light a space 20 feet deep. Lighting spaces past 20 feet deep are possible, but the ceiling height would need to be increased accordingly or be sloped away from the light shelf (Innovative Design). The figures below show how light shelves reflect the sun’s rays indirectly into a room.

Roof monitors are preferred if interior rooms are not oriented towards the south direction or to obtain natural lighting into spaces with no windows. Daylight and sunlight are admitted into the room by roof monitors. According to Oldroyd (2005), controlling direct sunlight is hard and the best avoiding method is using baffles and diffused glass. When light colored fabric baffles are installed parallel to the window glazing, they make ambient lighting in the room below as allowing reflected light to bounce of them (Innovative Design, 2004). The roof monitor should only admit natural light, which is coming from the north side and also, it should be four to eight percent of the floor area. Oldroyd mentioned in 2005 that reflective surface should be placed around the inside roof monitor to help with distribution of light and avoid glare and light colored (Pulay, Alana S. “Awareness of Daylighting on Student Learning in an Educational Facility.” Master’s Thesis, University of Nebraska-Lincoln, 2010.).
When the use of daylighting is designed incorrectly, it causes solar heat gain, discomfort, raised ventilation and air conditioning loads, and energy use, which conflict with design features of the LEED (Leadership in Energy and Environmental Design) (National clearinghouse for Educational Facilities, 2001). LEED is a certification process for green buildings developed by the U.S. Green Building Council to rate the sustainability of buildings (USGBC, 2010). Pulay (2010) mentioned that “A well planned daylighting system has balanced, diffused, glare-free daylight from two or more directions; sufficient and appropriate light levels; operable shading devices to reduce light intensity for computer screens; windows for views to the exterior; and exterior shading devices to minimize solar heat gains in the warm months.” For providing the most effective daylighting system, it must be used with automatic controlled electric lighting, which provides dimming in accordance with the space’s lighting levels (National Clearinghouse for Educational Facilities, 2001).

Even though LEED has been developed by USGBC for existing buildings, it provides the structure’s operations and maintenance system for these buildings. Today, most buildings, which have LEED certificates, are new construction. This has been able to influence the construction’s indoor air quality, sound control, color, lighting and...
overall aesthetics along with many design features contrast to an existing construction (USGBC, 2010).

**VI. BENEFITS OF DAYLIGHTING**

According to the Green School Initiative (Global Green, USA, 2005), daylight contributes to biological impulses, which balances body systems and mood, provides energy conservations and helps the benefits of the natural environment (Taylor, 2009). An internal clock, which is synchronized to the sunlight, controls all species’ behavior in the world, including humans. Thus, light is an initial aspect of internal clocks. According to Johnson, higher productivity is provided in a space by better views, natural light, temperature control and the mental advance of higher volume place. Gelfand (2010) claimed that natural lighting in classrooms can connect students to nature and also directly promote the mood of children and teacher. Research has demonstrated that windows provide benefits to people by daylighting and enable people to access views of outside and also provide a place where teachers feel happy and able to control their surroundings. Although it may not be said directly, the role of daylighting on the health of people is recognized for a long time. A school, which is designed by green school principles, provides benefits to students’ physical and emotional health.

Natural light in classrooms provides a healthy place for teaching, and enhances Vitamin D generation and circadian regulation. The amount of daylight is significant for vision of student and it restricts the negative impacts of electrical lighting.

According to Baker and Steemers, electric light can trigger strain, fatigue and circadian dysfunction of people. In addition, sunlight is an initial source for gaining Vitamin D, which is very important for people’s internal system. Based on Lucas and
Pousonby, a person who has less exposure to UV can develop a Vitamin D deficiency. Some research in 1910 and 1930 found that deficiency of Vitamin D induces abnormal bone formation and the amount of calcium in bones are decreasing. Thus, inadequate Vitamin D causes rickets, which is a health problem about the skeleton.

Scholars from the University of California, Berkeley stated that more efficient lighting for vision is provided by light sources, which are with rich spectrum. Furthermore, daylight decreases the stress on the eyes by generating the richest spectrum.

Knez (1990) and Veitch (1997) claimed that lighting influences people’s mood and attitude. The amount of lighting has an important mental function in educational facilities. According to Cakir’s research (1998) with the Federal Republic of Germany and the Ergonomic Institute, Berlin, lighting conditions cause more than 50% of health issues in offices. These researches demonstrate that not only personal health and well-being are affected by natural lighting, but also daylight is important for psychology. The lack of windows causes the stress on people (Cooper and Payne, 1988). Maslach and Jackson and Revicki et. al examined depression and stress on people and found out that there is a correlation between daylight and depression and stress. People need exposure to daylight for at least three hours to decrease stress and depression. Besides that, scholars claimed that a feeling of security is provided to students by natural light (Djamilo, Ming and Kumaresan, 2011).

When looking at effects of daylighting on students’ performance, Mirrahimi, Al-Mohaisen and Khattab said that adequate lighting can enhance conditions of classrooms to improve children learning and decrease rate of absenteeism at schools. Many studies in the U.S. shows there is a strong relationship between daylighting techniques (Windows
size, level of daylight, etc.) and student performance (L. Heschong, Wright, Okura, Klein, Simner, Berman and Clear, 2002). Based on Atre’s research, children tend to have better scores when they were examined with adequate lighting than those with inadequate lighting. Furthermore, Heschong et. al (2002) examined 8000 students in 450 classrooms and results showed that natural light directly affects children performance. Previous research of Heschong (1999) concluded that children in daylit classrooms promoted by 20% compared with children in non-daylit classrooms (L. Gelfand, 2010). According to Heschong et. al (1999), more than 21,000 students’ test scores about reading and math were analyzed, and found that the California students 20% to 26% increased in academic performance, while children in Seattle and Fort Collins showed about 7% to 18% developments. When compared with maximum daylight classrooms to with minimum daylight classrooms, students in maximum daylight classrooms improved math by 20% and reading by 26%. Learning areas at schools with maximum window areas were related to 19% and 20% better reading and math test scores (Boubekri, 2012).

<table>
<thead>
<tr>
<th>Table 1. Benefit of daylighting on students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Improved</strong></td>
</tr>
<tr>
<td><strong>Health</strong></td>
</tr>
<tr>
<td>Vitamin D</td>
</tr>
<tr>
<td>Student’s vision</td>
</tr>
<tr>
<td>Calcium absorption</td>
</tr>
<tr>
<td>Bone formation</td>
</tr>
<tr>
<td>Biological clock</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Figure 4-Daylight Benefits on Students

Source: Mirrahimi, Seyyedehzahra, Nik Lukman Nik Ibrahim and M. Surat “Effect of Daylighting on Student Health and Performance.”
VIII. TURKISH SCHOOLS

In the early Republic period in Turkey, when an educational building was to be constructed, the total costs of construction was determined and the citizens of that village or neighborhood split the amount of the construction costs. This result proved that in small settlements, constructing a school was difficult (Basgoz, 2005). The Amendment Law of Provincial Administrations and Decree of Primary Education was accepted for providing a balance between income of citizens and the collected tax. According to the 15th article of the Law, providing a land, building a school, and supplying salaries of teachers and other employees were covered by village citizens. After establishing The Republic of Turkey, the 1926 Law continued to be used by regulation of 1869 and the law of 1913. According to this scheme, the Central Organization of the Ministry of Education had all responsibilities about educational issues in the country. The Law of 1926 stated that all public educational buildings could only be built with a permission of and according to the projects sent by the Ministry of Education (Article:24). In the same year, a Construction Bureau was established under the Ministry of Education. The Construction Bureau prepared some prototype projects for school building and the projects was chosen by the joint decision of the local government depended on the population and educational needs. The special Provincial Administration built the selected prototype projects, but the taxes covered all construction expenses.

According to indirect sources in this period many schools were built with different type projects. However the loss of project archives by both ministries that are responsible for school construction, unavailability of inventories about the schools which were constructed by the Ministry of Education since its foundation and the collapse of the
buildings have made it difficult to reach information about all type projects which were designed in that period, their designers and the implementation of density. The only source about this is the Ministry of Education included type projects and documents which were prepared for disturbing other departments for giving idea about project types. The earliest document was believed to be the First School Plan Booklet in 1933. In this document included type projects of schools building and teacher houses which were planned to be built by existing construction materials as cheap buildings or economical buildings. The schools were built using some materials which were able to be found easily in the areas of the building like stone, adobe, brick and wood.

Tonguc in 1947 and Aslanoglu in 1992 mentioned that the Construction Bureau also commissioned a group under the leadership of Ernst Egli, who is a foreign architect, for designing of new and modern educational constructions. Whereas the Department planned and built some notable school buildings, prototype projects were also designed for primary schools of different scales to be built in the cities, provinces and villages. But until these prototype projects were implemented, the old buildings, which were coming from the last years of the Ottoman Empire, continue to be used as school buildings. The pictures show the condition of prototype schools in this period. The other sources about 1930’s school building is that after the Village Educators Law, a manual was published about two type projects. According to the manual, the school buildings had to be built with small expense, as relevant, durable, and simple buildings (Kul, Nursen. “Cumhuriyet Donemini Mimarligi: Erken Cumhuriyet Donemi Ilkokul Binalari.” Mimarlik Dergisi 360, (2011): 66-71.).
Primary education policies, which were prepared in 1920’s, spanned their testing stage in 1930’s and reached maturity level in 1940’s by establishment of the Village Institutes. Opening of the Village Institutes created an urgent need about school buildings in the villages for providing working areas to the Village Institutes’ newly graduated teachers. By this purpose, in 1941 an architectural competition was announced to promote projects for buildings of schools, lodgings and workshops that would be used by the Village Institutes’ newly graduated teachers. According to the competition conditions, the project which won would be applied in the villages of every cities in Turkey. Because of that, the architects, who would want to participate to the competition, had to propose three type projects by taking into consideration of hot, cold and temperate climate regions. The schedule of school buildings, which were designed according to the agreement of the competition, would include a classroom for 50 students, an atelier, a woodhouse and a teacherage, which had two rooms, a kitchen, a cloakroom, a restroom and a bathroom. The main intentions of the competition were the design of the project of easily applicable, simple and economical constructions, in which regional building materials and methods could be used. These intentions were claimed in the competition rules in detail and it was mentioned that candidate projects would be assessed accordingly. Asim Mutlu and Ahsen Yapanar became the winners of this competition. During the 1940’s, many of the schools country-wide were built by these type projects.
Figure 5- A Cold Climate School Building designed by Mutlu and Yapanar


In addition, the existing schools were accommodated with building teacherages and workshops by Mutlu and Yapanar’s type projects (Kul, Nursen. “Cumhuriyet Donemi Mimarligi: ErkenCumhuriyet Donemi Ilkokul Binalari.” Mimarlik Dergisi 360, (2011): 66-71.).

Figure 5- A Teacherage in Izmir designed by Mutlu and Yapanar in 1947

After 1950’s, because of the rapid population growth, economic reasons and migration from small villages to cities, the problem of a lack of school building was clear. Type project period has started in public buildings. For providing a solution to this problem, like in other public areas, type project implementation became popular and schools started to be built by the government based on these type projects.

Gur and Zorlu mentioned in 2006 that either time limitation or financial and personnel deficit caused this result. In order to reduce mistakes about planning school buildings and provide economic advance and type project implementation has still continued in Turkey (Karasolak, Kursat and Sari, Media. “Mimari Ozellikleri Farkli Okullardaki Ogrenci ve Ogretnmelerin Okullarinin Binasi Hakkndaki Goruslerinin Incelenmesi”, Cukurova Universitesi Egitim Fakultesi Dergisi 40, no.3 (2011): 132-154.). Even though standardized type project applications of school buildings have advantages about providing school investments, ease of anticipated cost, standardization opportunity, evaluating current resources country-wide, providing maximum project service with limited technical staff and minimizing project costs, Gur and Zorlu explained their disadvantages:

1) Type projects are not as economic as claimed

2) Standardized type projects cause functional problems because they don’t foresee social and educational developments at school buildings. For example, schools, which are built based on type projects, can be smaller than adequate for some neighborhoods while they can be bigger than adequate for other neighborhoods.
3) Type projects are generally unwieldy buildings, which don’t have relation of garden and classroom.

4) Type projects are not aesthetic physically and cause various sorts of climatic problems because they are built as ignoring regional climatic differences.

In recent years, school buildings have made progress within the scope of some research in the Ministry of Education. For instance, the Ministry of Education has started a new project, called “the Project of Catching the Era in Education 2000”, which updates the compulsory education requirements. Akar and Sadik mentioned (2003) that by 2000, school buildings should have better physical conditions than the school buildings in 1998 and before the year 1998 (Akar, V. R and Sadik, F. “Ilkogretim Okul Binalarinin Fiziksel Acidan Degerlendirilmesi” Egitim ve Bilim Dergisi 130, (2003):16-23.). Nevertheless, these studies are not enough to solve school building based problems. Today, a cooperation of experts in different fields is necessary to improve educational facilities at planning school buildings. Architects, engineer, and pedagogs should collaborate to build school as qualified facilities (Kucukahmet,1986). The school program, which was stated by the Ministry of Education in 2005, may be reflecting the sense of the modern education, when taking into consideration its goal, vision, content and approach. But as Tekbiyik and Akdeniz stated (2006), no matter how great the education program, if it is not used in education fields, it has no validity.

According to the studies of Unal, Ozturk and Gurdal in 1998, reading rooms, workshops, recreation centers, laboratories, inadequacy in the ratio between students numbers and classroom size, and garden access in school buildings are not appropriate to the standards. For example, Karakucuk (2008) proved by his examination of some
preschools in Turkey that these schools’ physical and spatial conditions were not appropriate to the specified requirements (Taner Derman, M. ve Başal, H. A. “Cumhuriyetin İlanından Günümüze Türkiye’de Okul Öncesi Eğitimde Niceliksel ve Niteliksel Gelişmeler.”, Uluslararası Sosyal Araştırmalar Dergisi, 11 no:3 (2010): 560-569.).

As a result, it is seen that lack of infrastructure and resources pose an obstacle to success. Unsuitability of buildings’ and classrooms’ physical conditions, desks and tables, inappropriateness of tables and desks for order of seating, surplus classroom size and lack of equipment are important problems in Turkish schools.
CHAPTER III: METHODOLOGY

I. OVERVIEW

The purpose of this study is to explore the impact of daylighting in the classroom on preschoolers’ cognitive and social skills as related to sunlight in classrooms. Children’s cognitive and social behavior were examined with input of preschool teachers.

II. PARTICIPANTS

Participants were chosen by Van provincial directorate for National Education in Turkey. Participants were 69 children (30 boys, 39 girls) enrolled in two different early childhood facilities in city of Van in Turkey. Children’s ages ranged from 4 to 5 ages (M=4.86 ages) at second semester the year (Spring, 2014).

I. MEASURES

Demographic Information: Teachers completed a questionnaire with demographic information like preschooler’s gender and age. For the complete Demographic Questionnaire, See Appendix A.

Social Behavior: In this study, School Social Behavior Scale (SSBC, Merrell, 1993-2002) was used to determine each target child’s social behavior. For the complete DDBC, see Appendix B. The School Social Behavior Scale was originally constructed by Merrell in 1993, and Yukay created a Turkish-language version of the School Social Behavior Scale in 2009. In this study, The Turkish-language version of the SSBC was used. The SSBC is a software tool to assess children’s social behavioral attributes. The SSBC was standardized using teacher ratings on a large group of kindergateners through 12th grader across school. In this study, teachers report was used because teachers may have more advantages to observe their students’ social behavior. The School Social
Behavior Scale includes total 64 items as 32 social items. The Social Competence part measures peer relation (14 items), self-management/compliance (10 items), and Academic behavior (8 items) subscales. Each SSBS scale is measured on a five point likert type scale: “never (1)”, “sometimes (2, 3, and 4)”, and “frequent (5)”. While the higher social competence results indicate greater levels of social adjustment, the higher anti-social behavior scale results indicate greater levels of anti-social behavior. Yukay (2009) found that satisfactory reliability values of the SSBC ranging between r=.91 and r=.98. These reliability values show that there is a similarity with those for the original version. For the present study the internal consistency of the Social Competence domain was good (α=.97).

**Cognitive Skills**

The Marmara Development Scale was constructed by Oktay and Bilgin-Aydin in 2002. The scale was used to measure children’s cognitive skills in this study. For the complete the Marmara Development Scale, see Appendix C. The Marmara Development Scale is a brief screening instrument to determine 3-6 year old (36-72 months old) children’s physical developments, self-care abilities, emotional developments, social developments, language developments and cognitive developments. The Marmara Development Scale has been used with preschool age children (Ogelman, Secer, Alabay & Ucar, 2012; Karsal & Malkoc, 2013). This subscale includes 53 items to measure children’s cognitive behavior in classrooms.

For the purpose of the present study, only the Cognitive Development Subscale scores were used to measure children’s cognitive abilities. Teachers’ report was used in the current study to measure children’s cognitive skills. Ogelman, Secer, Alabay and
Ucar (2012) used the Cognitive Skill Scale of Marmara Development Scale to measure preschool-aged children’s social and cognitive skills against the teachers’ report. The teachers completed a cognitive skills form for each student. In spring 2014, teachers rated their students’ cognitive skills on 5-point scale ranging from 1= never to 5= always. Bilgin (2002) found internal consistency of cognitive skills was \( \alpha = .97 \). For the present study the internal consistency of the Cognitive Skills was good (\( \alpha = .98 \)).

**Data Collection Procedures**

First of all in the data collection process, teachers were contacted through the schools who agreed to participate to this research. The teachers were informed about the forms, which they need to fill in for their students, and the purpose of the research. After getting consent from the teachers, depending on approximately six months experience on their students, teachers were given the School Social behavior and the Marmara Development Scale to complete their input about all participating children in their classrooms. Instructions were added to the scales for teachers. Teachers completed these surveys in about 30 minutes for each preschooler and returned them to the school directors or directly to the investigator. Teachers also completed demographic questionnaire for each students.

For measuring students’ social and cognitive skills in classrooms of early child facilities, two schools, which are public schools in Van in Turkey, were selected. School A’s classrooms do not have natural light inside, while School B has daylight in the classrooms. But both were designed using the standardized designs of the Republic of Turkey Ministry of National Education. In total, 69 children participated in this research.
by answering the questions of the School Social Behavior Scale and the Marmara Development Scale through their teachers. Data was entered to SPSS 15.0 statistical program.
CHAPTER IV: RESULTS

Data Analysis

Data were entered to SPSS 15.0 software to analyze. According to classrooms’ daylight conditions, students’ cognitive and social skills were examined, and cognitive and social behavior were scored in order to find a correlation between these skills and classroom daylight condition.

Preliminary Analyses

Bivariate correlations among variables were calculated (Table 3). According to the study results, children’s social behavior was not crucially correlated with students’ genders. Also, there was a non-significant correlation between students’ ages and social behaviors. When looking cognitive skills, there was no association between children’s cognitive developments and gender, and also preschoolers’ cognitive developments were not significantly correlated with students’ ages.

Children’s social competences were crucially correlated with classroom daylight condition (r=.20, p=.029, p<.05). Cognitive skills and classroom daylight conditions were also significantly correlated (r=.03, p=.01).

Research Question 1: Is there an association between children’s social behaviors and daylight in classrooms in preschools?

Bivariate Pearson Correlations were used to examine the associations between social behavior and daylight condition of classroom in early childhood facilities. The data of School Social Behavior Scale was entered SPSS and according to the T-Test results, a significant correlation was determined between children’s social behaviors and classroom
daylight condition (r=.20, p=.029, p<.05). The test results show that students’ social abilities in daylight classroom are more developmental than the students’ social developments.

**Research Question 2: Is there an association between children’s cognitive developments and daylight in classrooms in preschools?**

Bivariate Pearson correlations were used to analyze the association between students’ cognitive skills and daylight conditions of classrooms in preschools. The data was entered SPSS and t

The T-Test results of the Marmara Development Scale showed that students’ cognitive skills were significantly correlated with classrooms daylight conditions (r=.03, p=.01). According to the results, daylight classrooms affected students’ cognitive developments in a good way.
CHAPTER V: DISCUSSION

First of all, the research examined the association between students’ social behaviors and cognitive developments, and classroom’s daylight conditions in early childhood facilities. It was hypothesized that preschoolers’ social behavior would be correlated with classrooms’ daylight conditions. The results showed that there was a notable relationship between students’ social abilities and their classrooms daylight conditions. According to the current study, students’ social behaviors in daylight classrooms were higher than students’ social behavior in non-daylit classrooms in preschools. As mentioned previously, Gelfand (2010) claimed that natural lighting in classrooms might connect students to nature and also directly promote the mood of children and teacher.

Secondly, the current study examined the correlation between students’ cognitive abilities and classroom daylight level.

It was also hypothesized that there would be associations between students’ cognitive skills and daylight conditions of classrooms in early childhood facilities. The results revealed that there was a significant relationship between children’s cognitive developments and classrooms daylight conditions in preschools. Students’ cognitive skills in daylit classrooms were more developed than students’ cognitive behaviors in non-daylit classrooms. Results are consistent with Heschong et. al’s (1999) findings that natural light directly affects children’s performance. Previous research of Heschong (1999) demonstrated that student in daylight classrooms improved by 20 % compared with student in non-daylight classrooms (L. Gelfand, 2010).
Comparing these hypotheses to the results of study, it is obvious that both predictions have merit.

**Further Considerations and Limitation**

Several limitations of this study were kept in mind that must be considered in further research on this topic. First, this study is limited by public preschools in Van in Turkey. Future researches within a large region and different cities could more effectively examine association among variables and enhance the power of research by reducing probability error.

Another noteworthy limitation is that if all public schools are traditional building style, how can I find a school, which has good quality daylight in its classrooms, to compare with traditional ones? That is a big limitation for this study and because of that I have chosen schools from the private sector. Some of private schools have sustainable design criteria, whereas others don’t have any sustainable elements in their structures.

In addition, like in many researches, there are time constraints in the research, too. Spring semester in Turkey is starting in February and finishing in June, while spring semester is between January and May in the US. According to the difference between spring semester time of these two countries, the examination period of my research in preschools in Turkey is limited between middle of February and end of April.

Lastly, another limitation in my research is that because of lack of any educational psychology background, this research relied on the advice from an experts in order to measure students’ social and cognitive skills.

Future study of this one crucial interior design element, lighting, can expand on the current study that examined the subject at depth within the context of preschool design.
Subsequent research could vary regarding age and geography. Daylight is our primary light source which is indispensable, not only for the purpose of accomplishing work, but for its potential to foster comfortable interior environments that improve social and cognitive behavior.
References


http://sgo.sagepub.com/content/2/2/2158244012445585.


Pulay, Alana S. “Awareness of Daylighting on Student Learning in an Educational Facility.” Master’s Thesis, University of Nebraska-Lincoln, 2010


Table 1

*Participant’s Demographic Information*

<table>
<thead>
<tr>
<th>Child Characteristics</th>
<th>n (%)</th>
<th>Missing</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl</td>
<td>39 (56.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td>30 (43.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>69</td>
<td></td>
<td>4.87</td>
<td>.34</td>
</tr>
<tr>
<td>Age 4</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 5</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class Daylight Condition</td>
<td>69</td>
<td></td>
<td>1.51</td>
<td>.504</td>
</tr>
<tr>
<td>Daylight</td>
<td>34 (49.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Daylight</td>
<td>35 (50.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2

*Descriptive Statistics of Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Behavior</td>
<td>3.92</td>
<td>.74</td>
<td>1.09-5.00</td>
<td>.98</td>
</tr>
<tr>
<td>Cognitive Skills</td>
<td>3.4</td>
<td>.85</td>
<td>1.53-4.74</td>
<td>.97</td>
</tr>
</tbody>
</table>
Table 3.

*Correlations among Social Competence, Cognitive Skills, Gender, and Age*

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Social Competence</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Cognitive Skills</td>
<td>.520**</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Gender</td>
<td>-.109</td>
<td>-.005</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4. Age</td>
<td>-.083</td>
<td>.055</td>
<td>-.094</td>
<td>-</td>
</tr>
</tbody>
</table>
Appendix A: Complete Demographic Information Form

Demographic Questionnaire

Cover Sheet

Child's Name:________________________  Date of birth:______________

Child's gender (circle):  Male    Female

Child's school:_____________________  Child's teacher:______________

Language spoken at home?____________________________
Appendix B: School Social Behavior Scale

**SCHOOL SOCIAL BEHAVIOR SCALE**

Student:  
Class:  
Age:  
Gender:  

<table>
<thead>
<tr>
<th>SCALE A</th>
<th>(POSITIVE SOCIAL BEHAVIOR)</th>
<th>Never</th>
<th>Sometimes</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cooperates with other students</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Makes appropriate transitions between different activities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Completes schoolwork without being reminded</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Offers help to other students when needed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Participates effectively in a group discussions and activities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Understands problems and needs of other students</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Remains calm when problems are</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Listens to and carries out directions from teacher</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. Invites other students to participate in activities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Asks appropriately for clarification of instructions</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. Has skills or abilities that are admired by peers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. Is accepting of other students</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. Completes school assignments or other</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
tasks independently

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>14. Completes school assignments on time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. Will give in or compromise with peers when appropriate</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>16. Follows school and classroom rules</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. Behaves appropriately at school</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18. Asks for help in an appropriate manner</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19. Interacts with a wide variety of peers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>20. Produces work of acceptable quality for his or her ability level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>21. Is good at initiating or joining conversations with peers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>22. Is sensitive to feelings of other students</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>23. Responds appropriately when corrected by teachers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>24. Controls temper when angry</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>25. Enters appropriately into ongoing activities with peers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>26. Has good leadership skills</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>27. Adjust to different behavioral expectations across settings</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>28. Notices and compliments accomplishments of others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Question</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>29. Is assertive in an appropriate way when he or she needs to be</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Is invited by peers to join in activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31. Shows self-control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32. Is “looked up to” or respected by peers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## MARMARA DEVELOPMENT SCALE

<table>
<thead>
<tr>
<th>SCALE</th>
<th>Never</th>
<th>Sometimes</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Matches shapes</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. IS able to complete four-pieces puzzles</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Recognizes primary colors</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Tell numbers from 1 to 10</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Counts to twenty</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Only knows meanings of one, two and many</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Completes 4-6 pieces puzzles</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Draws a person with four to ten body parts</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Sorts five pieces object by ordering</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Draws a circle</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11. Matches 4-8 pieces matching cards</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12. Replaces three different shapes</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(circle, triangle, and square) to the shape board</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Recognizes different smells</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14. Recognizes different textures</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(rough, slippery, soft, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Uses concepts of morning, noon and evening correctly</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>16.</td>
<td>Tell the objects when is asked</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Is able to distinguish opposite concepts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Knows numbers from 1 to 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Uses concepts of yesterday, today and tomorrow correctly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Makes suggestions about solving a problem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Categorizes something</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Focuses his/her attention on something</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Knows people who he/she communicates with</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>Completes pictures’ missing parts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.</td>
<td>Does 10 pieces puzzles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.</td>
<td>Sorts the three pictures in order</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>Criticizes herself/himself</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>Names some money ($5, $10, $20, $50, $100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>Resume his/her game in next day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>Sorts items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td>Identifies his/her right and left</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32.</td>
<td>Identifies the seasons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33.</td>
<td>Demonstrates parts of human body when are asked</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34.</td>
<td>Creates games by himself/herself</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35.</td>
<td>Shows similarities on the pictures</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
36. Shows differences on the pictures  1  2  3  4  5
37. Says his/her own age correctly  1  2  3  4  5
38. Understands the words which states positions  1  2  3  4  5
39. Knows the concepts of half and whole  1  2  3  4  5
40. Counts to 100 by rote  1  2  3  4  5
41. Recognizes numbers 1 to 10  1  2  3  4  5
42. Arrays the numbers which are mixed  1  2  3  4  5
43. Adds the numbers 1 to 10  1  2  3  4  5
44. Subtracts the numbers 1 to 10  1  2  3  4  5
45. Identifies shapes  1  2  3  4  5
(circle, triangle, square, pentagon, etc.)
46. Completes 8-16 pieces puzzles  1  2  3  4  5
47. Performs succession of two tasks  1  2  3  4  5
48. Remembers parts of a story  1  2  3  4  5
49. Tells days of week respectively  1  2  3  4  5
50. Tells what time it is  1  2  3  4  5
(one o’clock, five o’clock, etc.)
51. Copies the letters  1  2  3  4  5
52. Understand time better (Daytime and night)  1  2  3  4  5
53. Sorts the five pictures in order  1  2  3  4  5
Appendix D: Letter of Information and Informed Consent

Title of the Study: Impacts of Daylighting on Preschools’ Cognitive and Social Developments
Researchers: Safak Dincer Yacan (Graduate Student)
Dr. Mark Hinchman (Thesis Advisor)

My name is Safak Dincer Yacan and I am a graduate student in Master’s of Science in Architecture at University of Nebraska-Lincoln. As a part of my masters’ I am completing a research project for my thesis.

Thanks for your time to participate to this research with this survey about how students’ cognitive and social developments are affected by daylighting’s impacts in preschools/ early childhood education facilities. In the survey, School Social Behavior Scale is used to evaluate your students’ social developments, while Marmara Development Scale is preferred in order to assess the students’ cognitive developments. Your answers for the survey will be used for my thesis project that will provide ideas about school design to current and future architects. The answers about your students’ cognitive and social developments will be kept confidentially and anonymously, and your identity will be protected at all times. The answers only will be used in the final report part as summaries.

Thank you for your time and please do not hesitate to contact me if you have any questions and concerns.

Safak Dincer Yacan
University of Nebraska-Lincoln
safak.dincer@huskers.unl.edu