

Developing a Model for Biophilic Public Schools Through Natural Light

A Creative Project

Submitted to the Graduate School

In Partial Fulfillment of the Requirements

For the Degree

Master of Arts

By Alexis Odette

Dr. Shireen Mohammad Kanakri – Advisor

Ball State University

Muncie, Indiana

Abstract

Schools everywhere are not suited to nourish student or adult minds, as well as their health and well-being. This study will go into Biophilic Patterns (Appendix 4) – specializing in the effects of daylight – within design and explain the importance of these patterns in relation to human evolution, and ways these patterns can be implemented into public school classrooms. This study will first go into the background of students and their current situation of wellbeing in the world today. After this, the study will go into the research previously conducted in five case studies. These case studies will be analyzed on several factors that will relate to the lighting and how students and teachers feel in these particular instances. Then this project will analyze how these patterns can be used to better the everyday lives of students; from this information there will be models as to how to incorporate these items into schools.

Keywords: public schools, Biophilic Patterns, wellness, schools, students, daylight, facilities, natural lighting, connection to nature

Table of Contents

I. Introduction.....	6
II. Literature Review.....	6
II.1. Public School Conditions.....	6
II.1.A. The Existing Condition of the Students.....	13
II.1.B. The Existing Condition of the Teachers.....	14
II.1.C. The Existing Condition of Design.....	16
II.2. Biophilic Theory.....	17
II.2.A. Natural Light.....	18
II.2.B. Impact of Biophilia on Humans.....	19
II.2.C. Impact of Biophilia on Students.....	21
II.2.D. Impact of Natural Light on Humans.....	22
II.2.E. Impact of Natural Light on Students.....	24
II.3. Summary.....	25
III. Methodologies and Results.....	26
III.1. Case Study One: The impact of Fluorescent and LED Lighting on Students Attitudes and Behavior in the Classroom.....	26
III.1.1. Reasoning.....	26
III.1.2. Lighting Systems.....	27
III.1.3. Lighting Effects on Students and Teachers.....	28
III.1.4. Lighting Effects as a Part of the Design.....	31
III.2. Case Study Two: Daylight Dividends Case Study.....	31
III.2.1. Reasoning.....	31

III.2.2. Lighting Systems.....	32
III.2.3. Lighting Effects on Students and Teachers.....	34
III.2.4. Lighting Effects as a Part of the Design.....	35
III.3. Case Study Three: High Performance Lighting for School Facilities.....	36
III.3.1. Reasoning.....	36
III.3.2. Lighting Systems.....	37
III.3.3. Lighting Effects on Students and Teachers.....	38
III.3.4. Lighting Effects as a Part of the Design.....	38
III.4. Case Study Four: The Case Study on Significance of Daylight in Classroom Setting at Sarajevo Campus.....	40
III.4.1. Reasoning.....	40
III.4.2. Lighting Systems.....	40
III.4.3. Lighting Effects on Students and Teachers.....	43
III.4.4. Lighting Effects as a Part of the Design.....	44
III.5. Case Study Five: Daylighting Impacts on Human Performance in School..	44
III.5.1. Reasoning.....	45
III.5.2. Lighting Systems.....	48
III.5.3. Lighting Effects on Students and Teachers.....	49
III.5.4. Lighting Effects as a Part of the Design.....	51
IV. Analysis and Discussion	51
IV.1. Summary of Key Findings.....	51
IV.1.1. Different Lighting Systems in Schools.....	52
IV.1.2. How Lighting Effects Students and Teachers.....	54

IV.1.3. How Lighting is Implemented through Classroom Design.....	58
IV.2. Recommendations and Design Deliverables.....	60
IV.2.1. Recommendations.....	60
IV.2.2. Existing Locations: A non-Invasive Retrofit.....	tbd
IV.2.3. New Locations: The Classroom Model.....	62
IV.2.3.A. Artificial Lighting Only.....	63
IV.2.3.B. Sunlight Only.....	67
IV.2.3.C. Artificial and Sunlight.....	69
V. Limitations & Conclusion.....	70
V.1. Limitations.....	70
V.2. Conclusion.....	71
VI. References.....	73

I. Introduction

Throughout this country, there are a large quantity of underfunded low-income schools (Appendix 13) or schools that do not get enough attention, to the point at which their facilities suffer and bring students and teachers further from their human origins within nature. As humans evolved, the species did so in nature, and most buildings today constructed in previous decades – including schools – do not make this consideration. It has been seen in studies past, that poor quality institutional facilities can have a negative impact on those within school buildings, and that good biophilic facilitates can have a positive impact on those within school buildings. This research will look at the state of how poor quality institutional environments compare to facilities with a higher standard – even to the point of incorporating or considering biophilic patterns (Appendix 4) into the schools – can affect students, teachers, staff in their overall well-being and productivity. This study will focus on daylight as a biophilic element through case studies that showcase the successful instances of newer more modern schools (Appendix 16).

II. Literature Review

II.1. Public School Conditions

Schools should be a place that creates a protective relationship with students and the adults in this environment that nourishes them into healthy adulthood and cultivate their innate human desire to have a relationship with nature. Sadness, hopelessness, and thoughts of suicide are at a higher rate than they were ten-plus years ago. Mental health affects their decision-making, schooling, and overall health (CDC, 2021). Public schools everywhere are currently

severely underfunded, and this is a huge issue being that one-sixth of the United States population attends or works at these buildings. However, there are leaders within cities, such as Miami, who are starting to create legislation to change this. One avenue that these leaders are looking at utilizing is the WELL Building Standard (Appendix 36) to create healthier schools



Figure II.1. A student at the Garden School playing with an interactive nature-inspired installation (Olsen, 2019).

(IWBI - June 2022) which in a way adds to the biophilic patterns (Appendix 4). There are also



Figure II.2. Hexagon shaped cubes at Garden School to offer students a place of refuge (Appendix 26) (Olsen, 2019).

innovators in the United Kingdom who have created what is known as the Garden School for children with autism to have a place to have an outdoor experience inside away from the overstimulating playgrounds. These spaces give them a direct sense of wonder and comfort which are parts of different patterns of Biophilia (Appendix 3) (Olsen, 2019).

Humans are at a point where at which they spend around 90% of their time indoors. This is unnatural for humans because this species has spent so much of their evolution out in nature with this deeper connection to the world around that surrounds everyone . This concept is known as Biophilia (Appendix 3) or the Biophilic Patterns (Appendix 4). Biophilia (Appendix 3) is an



Figure II.3. Human connecting in a natural view (K. Rogers, 2019).

important concept to consider when designing for the sake of human health. This is because the Biophilia Hypothesis (Appendix 3) is the "idea that humans possess an innate tendency to seek connections with nature and other forms of life," (K. Rogers, 2019). This comes from the human

genetic basis growing and evolving in a close relationship to nature and the world in which the human species lives. Humans not only have this deep longing for this connection to nature, but they also have higher levels of happiness and satisfaction in a natural environment (K. Rogers, 2019). In fact, there are ways to incorporate these ideals into a building's design as there are