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Title

A New School: Alternative Learning Environments for the Future

By

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The Supervisory Committee certifies that this ***thesis*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF ARCHITECTURE

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A NEW SCHOOL: ALTERNATIVE LEARNING ENVIRONMENTS FOR THE FUTURE

A Thesis
Submitted to the Graduate Faculty
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By

Braden James John

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ABSTRACT

The benefits of how educational architecture can leverage outdoor spaces and natural light to enhance learning, and promote sustainable learning is important to study for the future of the education system and how we can enhance our children's future. Research will explore existing studies, analyze quality and subpar current projects, and explore additional sustainable factors that can help the educational environment. This research introduces a better understanding of how vital getting students in daylit and outdoor access environments is to shape the future of education and sustainable design.

ACKNOWLEDGMENTS

Special thanks to my peers, professors, and friends at North Dakota State University for their ongoing encouragement and support through the curation of this document, and the goal of creating a new school for the future of our education system. Thank you to Regin Schwaen for teaching thesis and being a great resource throughout the research phase, as well as encouraging viewing problems in different perspectives. Thank you to my friends and family who continue to support me each and every day.

DEDICATION

This thesis is dedicated to my mother Jenny John who has been a preschool and elementary school teacher my entire life and inspired me to research the future of education architecture. I would also like to dedicate this to my many teachers and school staff who helped me along the way, from preschool to master's thesis, and provided me with the opportunity to learn.

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LIST OF ABBREVIATIONS

STEM.....Science, Technology, Engineering, Math

LEED .....Leadership in Energy and Environmental Design

ADHD.....Attention Deficit Hyperactivity Disorder

CDC .....Center for Disease Control

CMU .....Concrete Masonry Unit

1. INTRODUCTION

The design and construction of educational facilities play a pivotal role in shaping the future of our cities and society, as it is the place where our future leaders come to learn. However, many urban schools are plagued by inadequate learning environments, with minimal natural light and outdoor interaction. This can hinder students' cognitive development and overall well-being. There is a lack of attention paid to the incorporation of outdoor spaces and natural light within educational environments. Many classrooms have few windows or no windows, are concrete boxes that are intended to fit as many students as possible and lack any greenery or natural elements. Even outside most schools there are few trees, and large swaths of manicured grass with the school building placed in the middle. Numerous studies have shown that exposure to outdoor environments and natural light can significantly enhance learning outcomes, yet a comprehensive framework for their implementation remains nowhere to be found. Outdated thoughts and the economic outlook on what a school needs to be successful have held back many educational institutions from acting on positive new studies. This is due to the fact that they contradict the popular and misguided beliefs that have negative impacts on learning.

1.1. Problem

The American education system has remained mostly unchanged since the 1960's following several controversial changes in thought, with few changes in the way classrooms and learning is introduced. As more and more students develop learning disabilities/challenges, such as ADHD, confining them to small indoor classrooms without distractions is not the solution. This problem requires a thorough investigation into how schools can be transformed through architectural design to create more sustainable, engaging, and effective learning spaces.

1.1.1. Rise of Learning Disabilities

As learning disabilities rise in the United States alternative learning environments are important to provide environments that fit different learning styles. In The Institute of Education Sciences 2021 report they show “From school year 2009–10 through 2019–20, the number of students served by the Individuals with Disabilities Education Act increased from 6.5 million to 7.3 million and the percentage served increased from 13 percent of total public school enrollment to 14 percent.”(Irwin et al., n.d.) Of these disabilities the highest percentage are learning disabilities that are often overlooked and made to learn the same way as all other students. The one size fits all standard of the United States education system must be reevaluated to make sure that there is a learning environment fit for students with these disabilities.

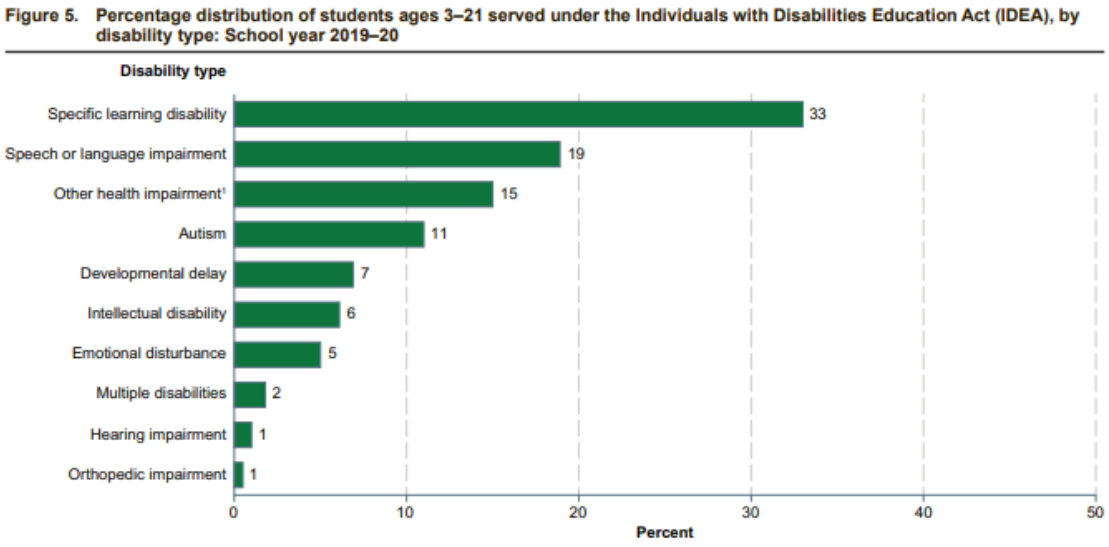

Figure 1.1. “Educational Disabilities” (Irwin et al., n.d.)

1.1.2. ADHD

In recent years there has been a rise in learning disabilities such as ADHD. ADHD affects 8.4% of children ages 2-17 years old. (Zgodic et al., 2023) People who have ADHD struggle to focus, pay attention, and are often categorized as being overly active. The CDC describes symptoms of ADHD being “daydreaming a lot, forget or lose things a lot, squirm or fidget, talk too much, make careless mistakes or unnecessary risks, have a hard time resisting temptation, have trouble taking turns, and have difficulty getting along with”.(CDC, 2021) These symptoms are often seen in schools where students are forced to stay at a desk, and learn in ways that are not conducive to students who are diagnosed with ADHD.

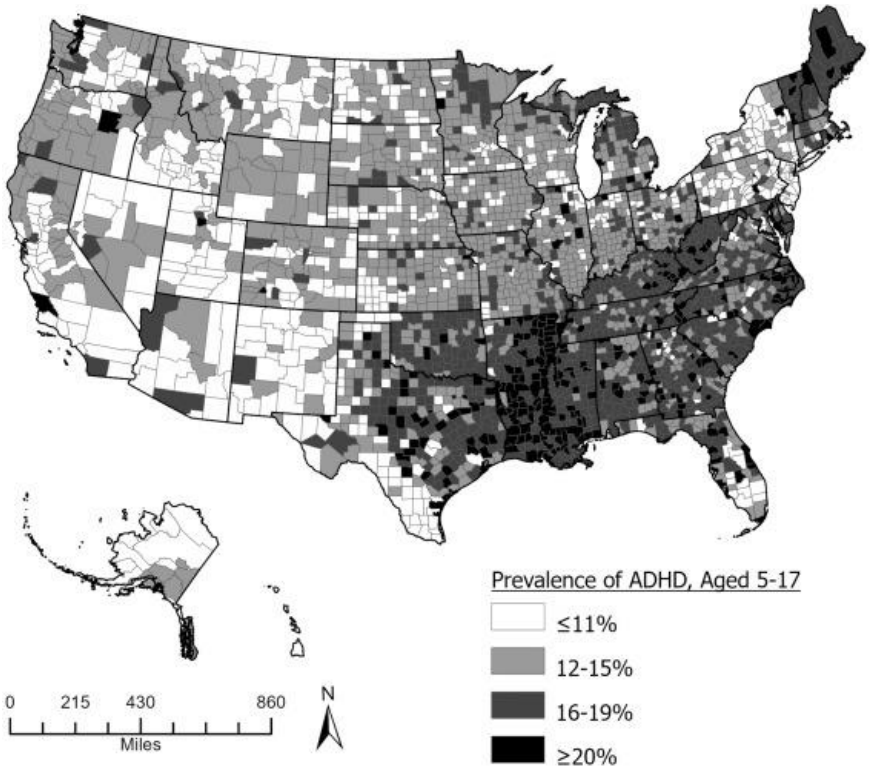

Figure 1.2. “Prevalence of ADHD” (Zgodic et al., 2023)

ADHD prevalence varies throughout the United States but is most affected in the southeast where it is common for ADHD to be 16% to more than 20% of children aged 5-17. (Zgodic et al., 2023) In populations of black and Hispanic children there was a higher prevalence of ADHD believed to be caused by socioeconomic hardships and lack of resources. (Zgodic et al., 2023)

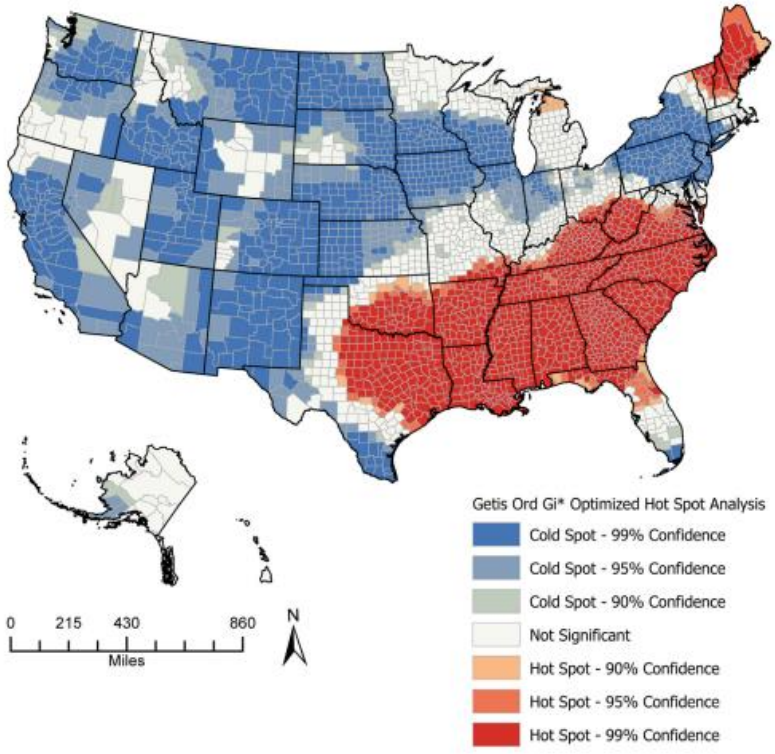

Figure 1.3. “ADHD Hotspots” (Zgodic et al., 2023)

The presence of ADHD in the education system, and its rise, is significant due to the idea that nearly 10% of students are unable to learn to their best ability in classrooms that were designed for neurotypical students and have a much harder time learning. According to the CDC “For the 2007–2009 period, an annual average of 9.0% of children aged 5–17 years had ever been diagnosed with ADHD—an increase from 6.9% in 1998–2000”.(Akinbami, 2011) As these

numbers increase the education standards have to react and provide alternative ways to allow children with ADHD to have opportunities to learn that are focused for them. This includes the spaces that they learn in. The focus region of research and site in the Midwest has one of the largest increases of ADHD in the country. The CDC shows “ADHD prevalence rose from 1998–2000 to 2007–2009 in the Midwest region (from 7.1% to 10.2%)”. (Akinbami, 2011) This being the highest increase of any region shows the benefit of analyzing it throughout this research and provide a precedent to combat the continued rise.

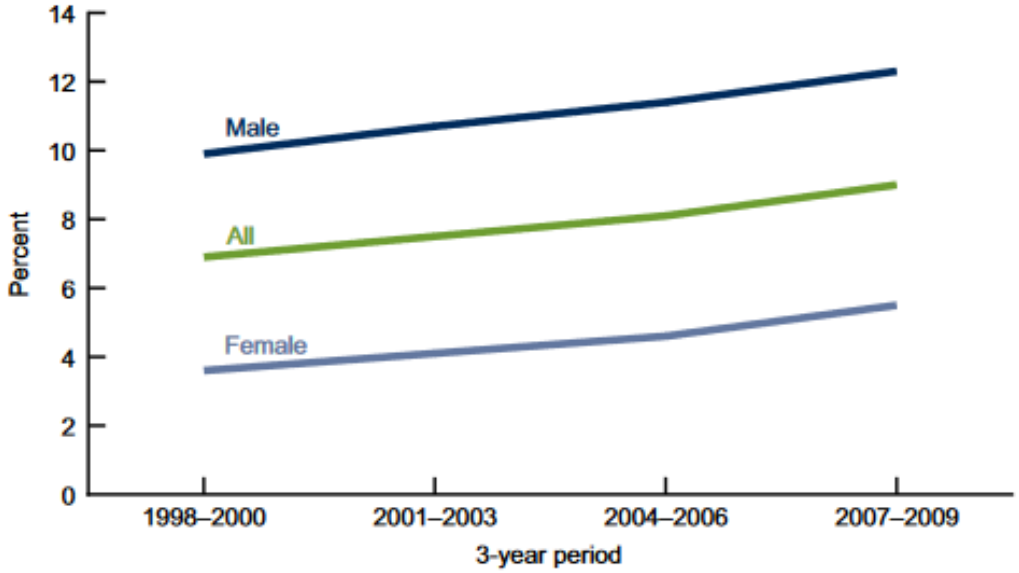

Figure 1.4. “CDC ADHD Trends” (Akinbami, 2011)

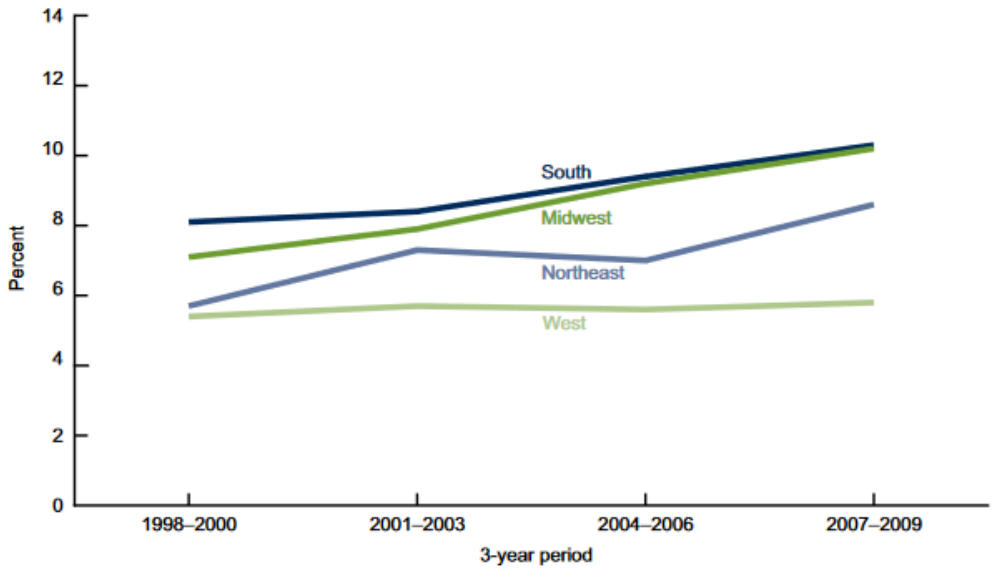

Figure 1.5. “CDC ADHD by Region” (Akinbami, 2011)

1.1.3. Lowering Educational Success

In the 1900’s the United States was statistically in the top ten for education but has gradually fallen off the charts and continues to lower on the list of international education. According to Finn “The U.S. is being out paced by dozens of other countries. In the most recent international assessment, 2015 for example, we didn’t make it into the list of top ten countries in math or science or reading”. (Finn, 2019) This is extremely concerning, and a wakeup call that our education system cannot stay dormant but must be proactive, introducing alternative learning opportunities to encourage learning. “Over the past decade, there has been no progress in either mathematics or reading performance, and the lowest performing students are doing worse…. in reading, the lowest-performing students—those readers who struggle the most—have made no progress from the first NAEP administration almost 30 years ago.” says Peggy Carr, the associate commissioner of the National Commission on Excellence in Education. (Finn, 2019) In a 2019 TIMSS, Trends in International Mathematics and Science Study, it was concluded that

"the United States scored in the top 25% of education systems in both mathematics and science at both 4th and 8th grade levels".(Irwin et al., n.d.) While still a top education system this percentage has been dropping and will continue to drop if education isn't re-evaluated and alternative solutions aren't provided for students who can't perform in traditional environments.

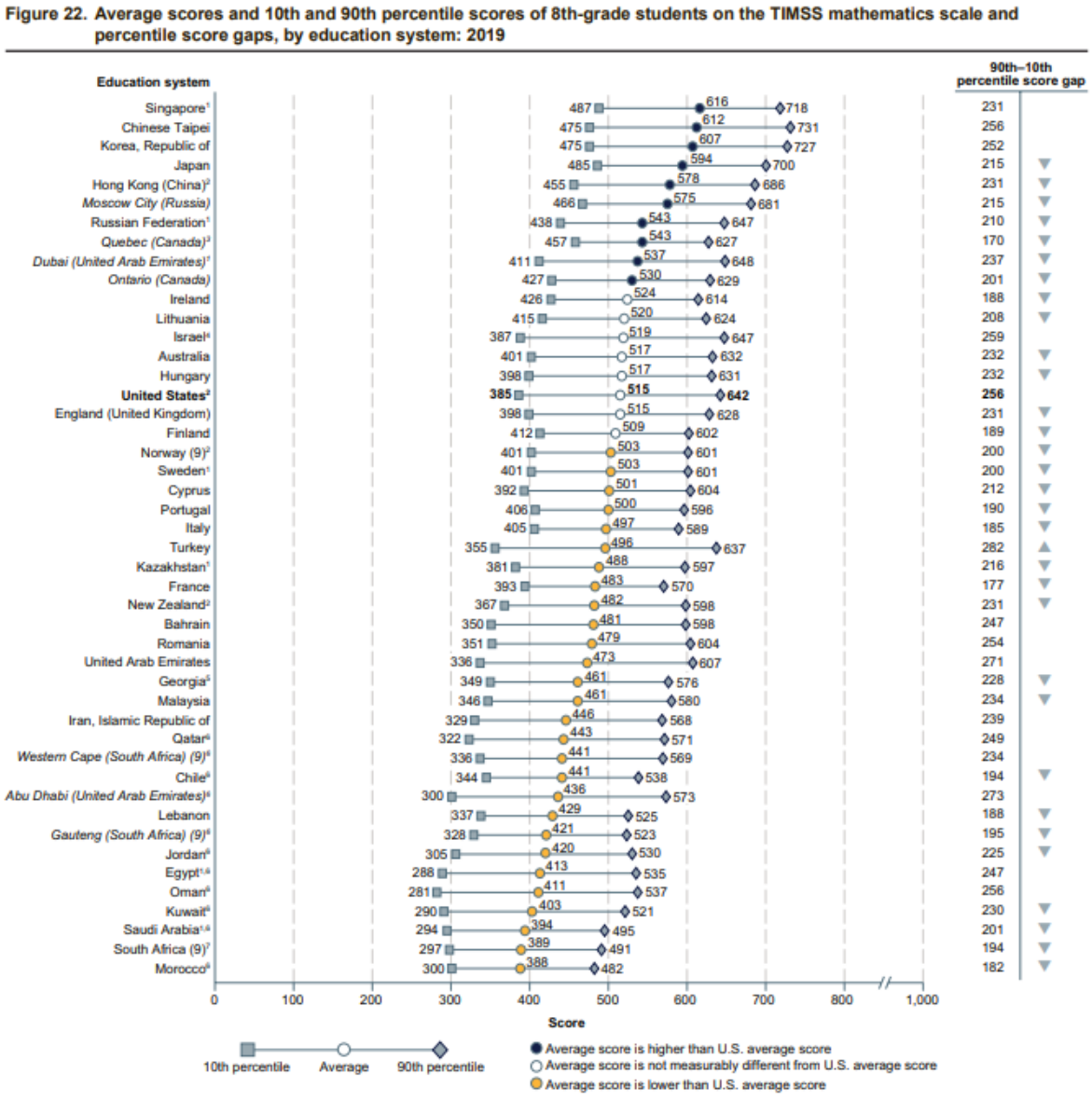

Figure 1.6. "TIMSS Math Percentiles" (Irwin et al., n.d.)

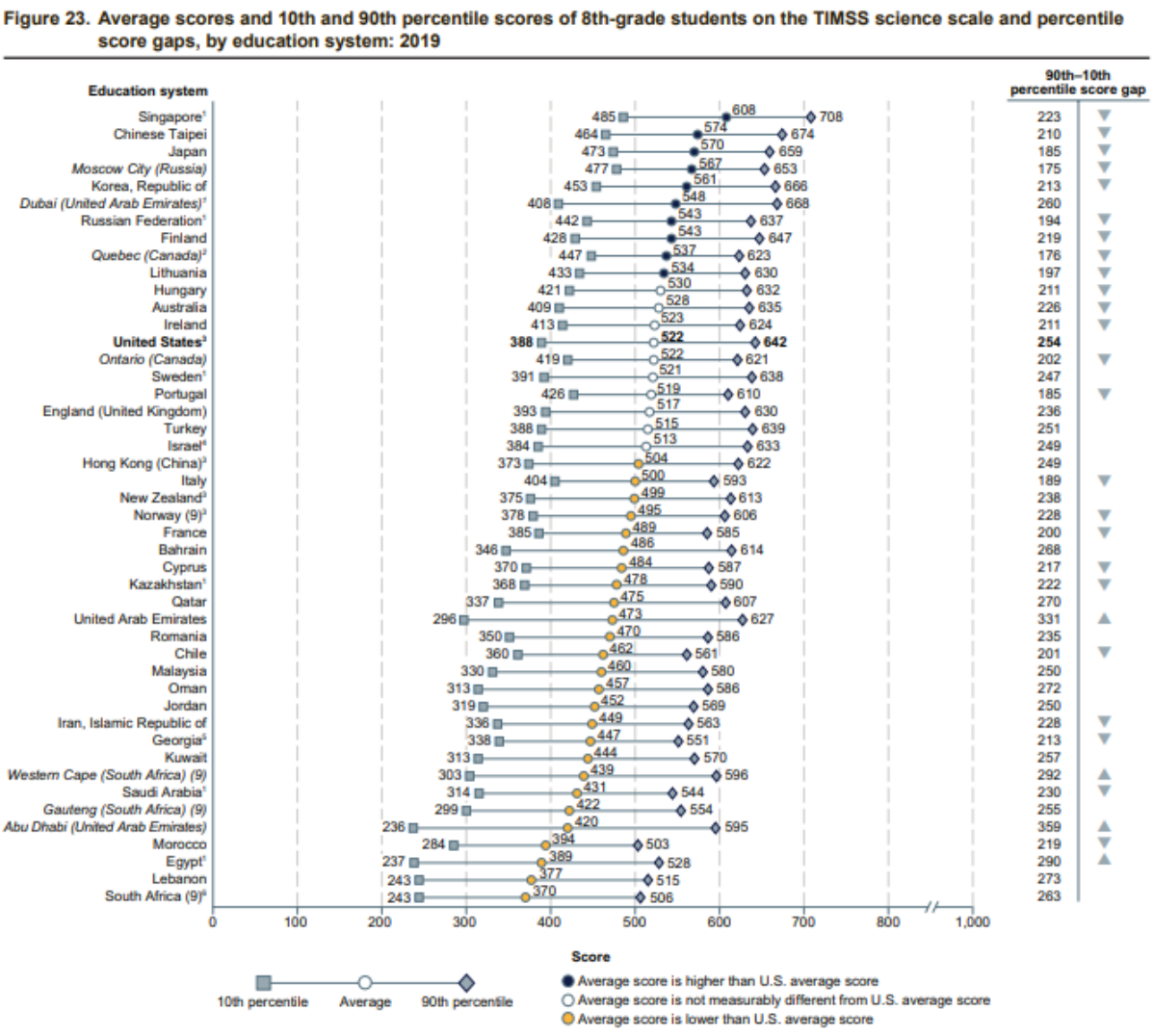

Figure 1.7. “TIMSS Science Percentiles” (Irwin et al., n.d.)

1.1.4. Outdated Facilities

In the late 1900’s schools were designed based on a construction economist view that claimed, “schools could be built more inexpensively on smaller sites if the classrooms could be grouped together in modules, without constraints on solar orientation.” (Heschong et al., 2002) This outlook led to schools designed with a focus on affordable construction rather than the most beneficial learning environments for students. Many schools today are still a remnant of this

view and have limited daylighting, ventilation and sustainable practices that are now recommended to create the best learning environment. Studies such as the 1965 study on windowless classrooms by the University of Michigan, which claimed windows and daylighting were not beneficial to learning, negatively impacted learning, and hence created facilities that are now opposing current studies and outdated. (University of Michigan, 1965) Even if facilities aren't that old, they are outdated in ideas. They are of a thought that does not support the most beneficial learning environment known today, and often have limited daylighting and other factors now known to be beneficial.

Figure 1.8. "Stanley M Makowski Early Education Center" (American, 1996)

1.1.5. Education as a Linear Path

Many education systems are set up to be a one size fits all linear path education, not allowing variation in how children learn. Most students in the United States follow a progression of grades K-12 that leave some kids behind while not challenging others. Students that are considered above standard in test scores in elementary school and put in accelerated classes are often found to burn out and lose motivation in high school from being put back into an environment where they are no longer challenged. Creating environments where students are motivated and in thought provoking situations can help this and help those who fall behind have better stimulation as well. With 14% of students enrolled in school also having a learning disability the linear path system does not prioritize a significant number of students. (Irwin et al., n.d.) Providing alternative paths, depending on a student's needs, and a facility that is beneficial to all students, can combat the exclusion of underperforming or mentally disabled students from an ideal education.

1.2. Objective

The proposed project is an alternative education school that employs strategies found in research to create the best possible learning environment for children; specifically in grades K-5. The goal of this school is to help kids learn instead of simply being a vessel where learning occurs. The research studies the solutions and proposals to the problems of educational facilities and how architecture/design can mitigate these problems. Research will start with a look at the background and origins of the education system common today and studies that were done throughout the mid to late 1900's that led to a negative learning environment today. Case studies throughout the 1900's and precedent schools already initiating these strategies are also included

to show a trend in where educational design has been and is going. Additionally, research will analyze a variety of statistics on the effects of architectural and environmental features on students and implement the positive features affecting learning into a school design. This will be conveyed through results and an architectural school design implementing the beneficial features found during research.

2. BACKGROUND

There are many factors that affect the lowering educational success and education problems across the United States. Most of the factors are independent of each other and just correlate to the general negative trends of the education system. One factor could greatly impact a multitude of other factors, from lowering success to the rise in learning disabilities, is a focus on educational architecture and creating an alternative school proposal that has more of a positive impact on learning than a traditional school. Some architectural features that affect many other educational problems are windows/daylighting, outdoor access/learning, and sustainable features.

2.1. Project Type

Research will focus on educational facilities specifically K-12 schools in the United States. The educational facility will be an elementary level school focused on grades K-5. In these early grades alternative learning strategies are most impactful since hands on, sensory, and environmental learning are much more important to the educational outcome. The project will focus on creating a school that can be a part of an existing school district and will serve as an alternative learning environment to the other schools in the district.

2.2. Project History

Throughout history the concept of a school has continued to change. The reasons for these changes are often results of industrial, social, and economic progression. The most recent big change in the education system is the physical school architecture for K-12 schools. Schools today are designed as a result of the last change in views of what a school should be in the 1960's and 70's, post-World War II. The United States education system was once one of, if not the best education system in the world, but now suffers from lowering educational success, outdated facilities, and rises in learning disabilities. There are many reasons the education system is lowering on international lists, but one of the reasons affecting many aspects of education could be the outdated facilities. (Irwin et al., n.d.) Through the 1900's schools went from being designed with the student in mind, to being designed with students and economics in mind, to being solely built based on economics and affordability. New research on architecture features that affect learning, show that schools in the early 1900's were closer to an ideal school design than the end of the 1900's. Case studies show the progression and effects of changes of thought in the 1900's and how school architecture changed through the century.

2.2.1. Early 1900's

In the early 1900's schools were designed with a focus on the outdoors and daylighting. Many schools focused on giving views of the outdoors and using windows to allow daylighting to illuminate the classrooms. School design in the early 1900's remained vastly unchanged with windows and a focus on students until post World War II when modular, affordable schools and several controversial school studies came out changing the projection of educational architecture

for the rest of the century. Many of the schools in the early 1900's are much closer to what studies have shown are ideal learning environments than counterparts in the late 1900's.

2.2.1.1. Case study 1 : 1930 Open-Air School Amsterdam

The Open-Air School in Amsterdam was built in 1930. The school was designed with the idea that "Physical and intellectual development were equally important for the child." (Roth, 1958) With that in mind, classrooms were designed to maximize daylighting, terraces were designed to be used in all weather conditions, and windows were operable for ventilation. (Roth, 1958) This design created a good learning environment for the students but was eventually diminished by three story apartments encircling the school. Once the three-story apartments were added it was said that "It's present situation in a comparatively narrow courtyard is now unsuitable for schoolwork as it is unpleasant for the inhabitants of the flats." (Roth, 1958) This supports the notion that in the early 1900's a focus on creating educational facilities open to the environment was common and when the daylighting effects were lost by nearby buildings it was viewed as no longer being a great facility.

Figure 2.1. “Open Air School Amsterdam 1930” (Roth, 1958)

Figure 2.2. “Open Air School Amsterdam Interior” (Roth, 1958)

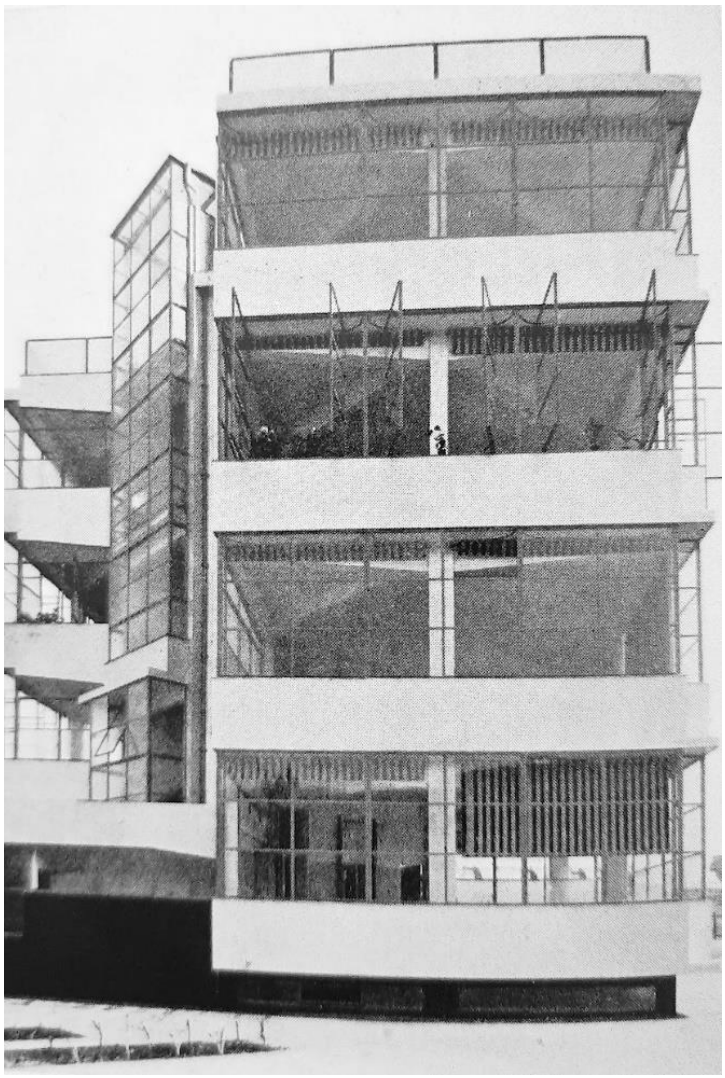

Figure 2.3. “Open Air School Amsterdam Windows” (Roth, 1958)

Besides daylighting, the open-air school focused heavily on fresh air and ventilation, and it is shown in the operable windows throughout the building. The terraces also allow any-weather use, due to the overhang and covered area from the floors above. The terraces as well as the flat roof were intended for outdoor teaching when the weather is nice. (Roth, 1958)

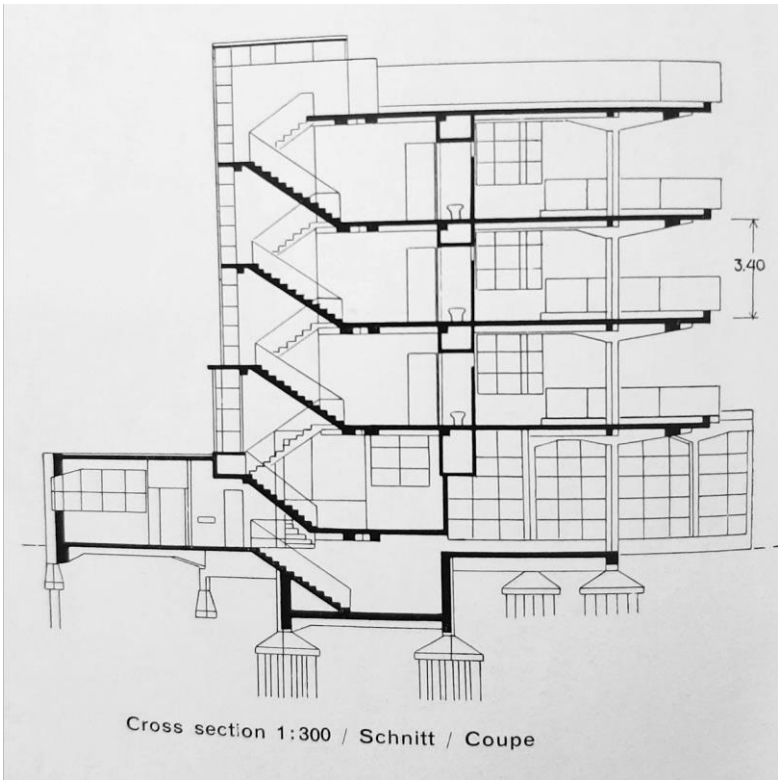

Figure 2.4. “Open Air School Amsterdam Section” (Roth, 1958)

2.2.1.2. Case study 2 : 1935 Sant’ Elia Kindergarten – Giuseppe Terragni

Sant’ Elia Kindergarten designed by Giuseppe Terragni in 1935 shows how schools were designed in the early 1900’s. A large 40m courtyard in the center provides an area for students to go outside and provides natural daylighting for the classrooms. (5 Emblematic, 2016) The central courtyard also has an orientation so that the building and courtyard receive the maximum amount of sun.

Figure 2.5. “Sant’ Elia Courtyard” (5 Emblematic, 2016)

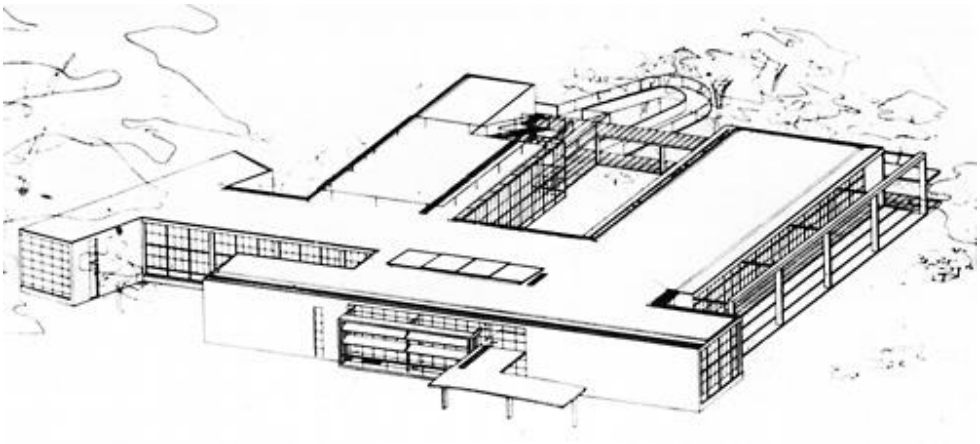

Figure 2.6. “Sant’ Elia Sketch” (Sant’Elia, n.d.)

Another significant feature of Terragni’s design is not only the use of expansive amounts of glazing but also the use of velarium curtains. Velarium curtains were common in the roman times and would protect from direct sunlight. In the courtyard there are concrete columns that

have the curtains originally designed into the architecture and diffuse the sunlight through the glass.

Figure 2.7. “Sant’ Elia Velarium” (Sant’Elia, n.d.)

Figure 2.8. “Sant’ Elia Interior” (Sant’Elia, n.d.)

2.2.2. Mid 1900's

In the mid 1900's and following World War II a change in thought began to occur in how architecture was designed and constructed. Following the industrialization and war effort architecture began to focus on prefabrication and affordability. This began to play a role in educational facilities as construction economists proposed that schools could be built much more inexpensively as well as take up less space if they are designed in a modular system. (Heschong et al., 2002) This view led to schools beginning to shift from a focus on the students, to a focus on constructing schools as affordable as possible. This began to affect schools designed in the mid 1900's as affordability became the attractive feature to the government. As this began to affect school design, several other studies, such as the 1965 University of Michigan study on windowless classrooms, that claimed daylighting is not necessary for classrooms, gave the green light for schools in the late 1900's to design in this flawed way. (University of Michigan, 1965) A few schools during this time period were outliers and still implemented a design focus on daylighting and the outdoors, some bridged the gap between the two and others took a full economic route that resulted in environments that hindered educational progress.

2.2.2.1. Case study 1 : 1960 Montessori – Herman Hertzberger

Figure 2.9. "Montessori Facade" (Architecture, 2017)

Herman Hertzberger designed a Montessori in 1960 that had features of early 1900's school design while also some of the modular features found in the post war era. Montessori schools have an alternative learning style that is different to most schools in that there is no linear relationship with teachers and students. (Architecture, 2017) This means that students can be doing a variety of tasks all while being in the same classroom. Hertzberger solved this issue by designing classrooms where students could sit by the windows for ample daylighting to work on schoolwork or they could go to a different area in the classroom. The classrooms at the Montessori were designed in an "L" shape so that a variety of activities can be going on by different students but that there can be somewhat of a disconnection from distractions. (Architecture, 2017)

Figure 2.10. “Montessori Interior” (Architecture, 2017)

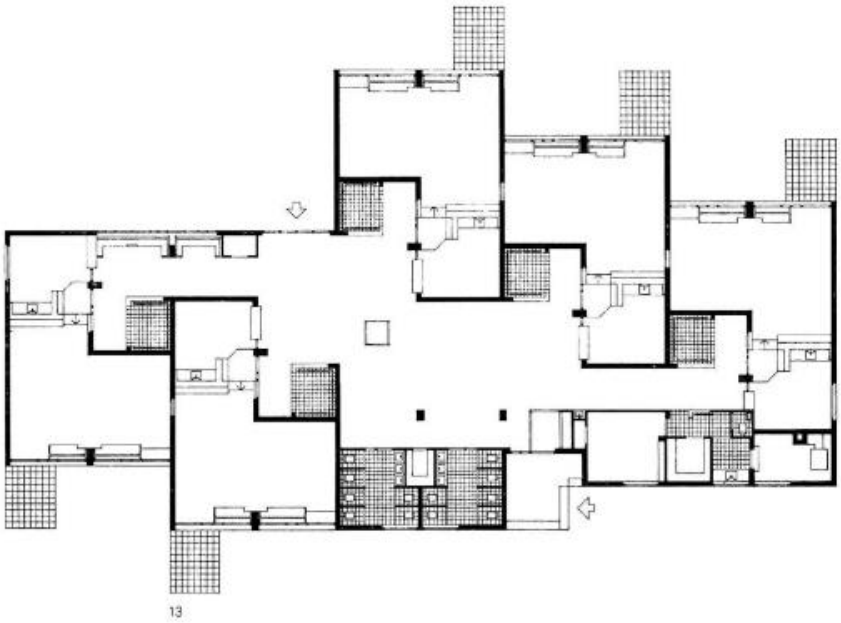

Figure 2.11. “Original Montessori Floorplan” (Architecture, 2017)

The Montessori was designed with CMU blocks being the main material. Many schools designed in the mid-late 1900’s began exclusively using this material due to its affordability and easy constructability. Hertzberger used it well compared to some of his later counterparts in the way that he still incorporated lots of daylighting. Not only were there large windows and daylighting in the classrooms but he also designed daylighting towers in the center of the school to bring daylighting into all areas. The school’s original concept is described as “groupings of self-contained units” and “in principle provide for extensions”. (Architecture, 2017) This is representative of the economic view of the time and the school was expanded soon after in a similar style.

Figure 2.12. “Montessori Exterior” (Architecture, 2017)

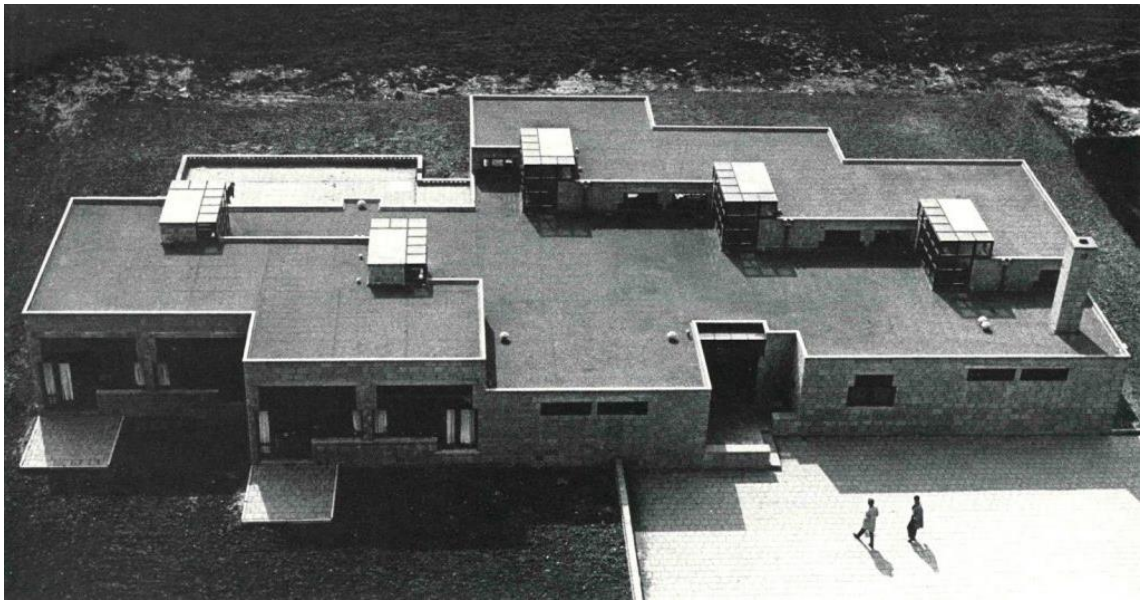

Figure 2.13. “Montessori Aerial” (Architecture, 2017)

2.2.2.2. Case Study 2 : 1957 Munkegaard School - Arne Jacobson - Dorte Mandrup

Arne Jacobson designed Munkegaard School in 1957. The Danish school may be one of the last few schools designed to not only support the educational theorist view and the economist view before the transition to a purely economist view in the late 1900's. Munkegaard School was designed with a large focus on daylighting and outdoor space for its students. Every classroom of Munkegaard school is oriented south to bring ample amounts of sunlight in the windows and clerestory. (Roth, 1958) Another feature of significance is the design of one courtyard for every two classrooms. Indoor/outdoor learning and student focused design makes Munkegaard an iconic and significant case study to the future of education architecture.

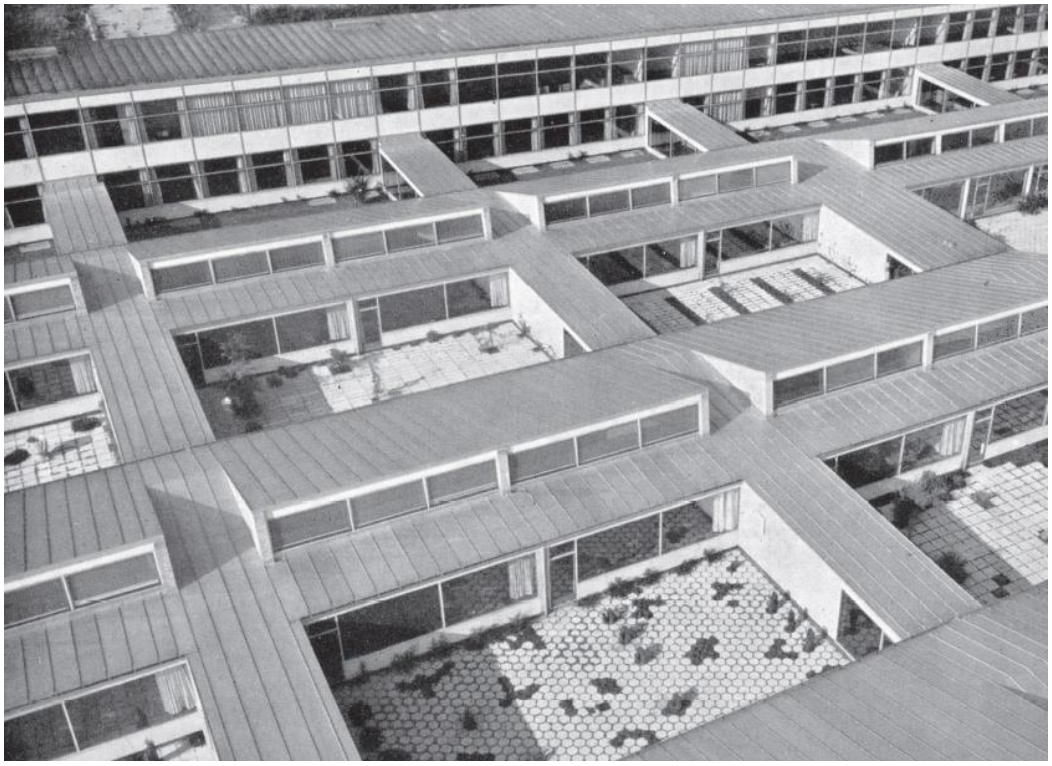

Figure 2.14. "Munkegaard School Original Aerial" (Roth, 1958)

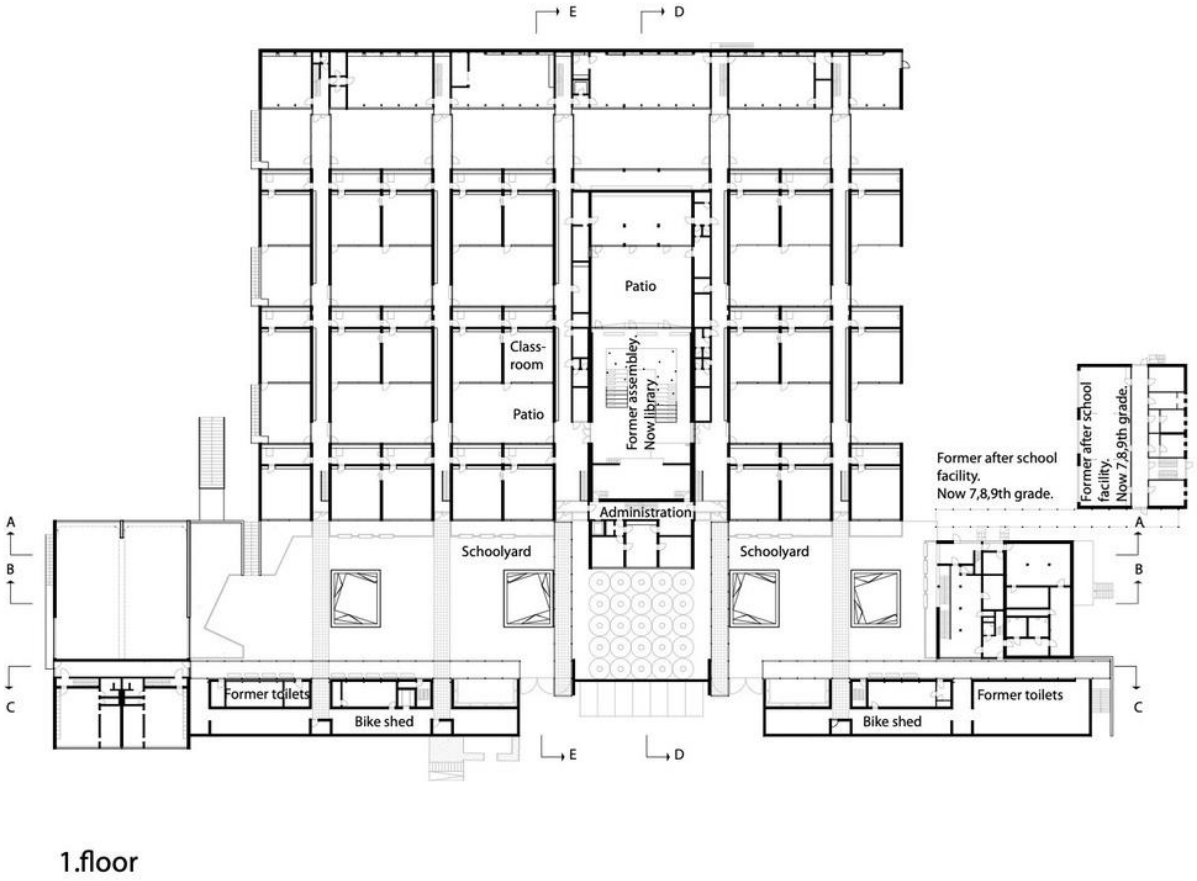

Figure 2.15. “Munkegaard School Plan” (The Munkegaard, 2019)

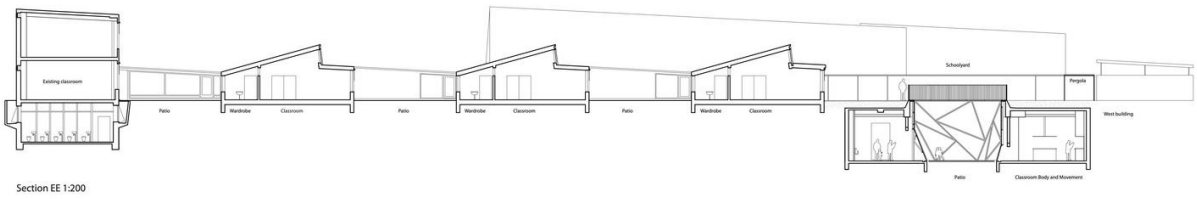

Figure 2.16. “Munkegaard School Section” (The Munkegaard, 2019)

Figure 2.17. “Munkegaard School Outdoor Areas” (The Munkegaard, 2019)

In 2009 architect Dorte Mandrup led a restoration and modernization of the historic school mainly focused on the lower-level underground spaces. (The Munkegaard, 2019) Mandrup followed Jacobson’s original design for the school and created a light filled lower level that now houses science labs and student community spaces. Light fills the lower level and students can go out into the courtyard if they desire.

Figure 2.18. “Munkegaard School Lower Level” (The Munkegaard, 2019)

Figure 2.19. “Munkegaard School Lower Courtyard” (The Munkegaard, 2019)

2.2.3. Late 1900's

The late 1900's educational facilities were designed predominantly without the beneficial learning environments that we know today, in mind. The schools were designed from the economist view that emerged in the mid 1900's and were constructed as affordable and compact as possible. Schools began to become very large where students from an entire district would come to learn, and the individuality of the student began to be lost. During this time classrooms had less windows than ever before, backed by studies that claimed windowless classrooms were better or less distracting. (University of Michigan, 1965) This was later shown to have the opposite effect and led to many non-conducive learning environments. By the time that new studies and results came out the damage was already done, and many schools were built with negative features. During the end of the century there was an increase in schools being built due to the "baby boomer" generation having kids and a second rise in population. This could not have come at a worse time, since the shift in what a school should be had made a full shift, leading to most of the schools from this era being designed in a way that is now known to have a negative impact on learning.

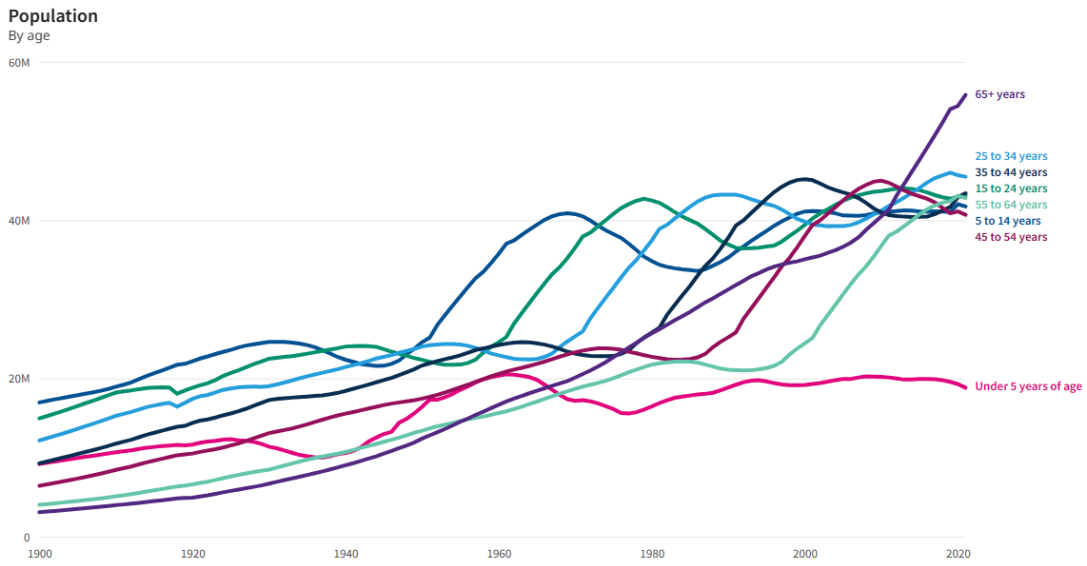

Figure 2.20. “United States Population Age” (US Population, n.d.)

2.2.3.1. Case study 1 : 1993 Amelia Elementary School – Bond Comet Westmoreland + Hiner Architects

Amelia Elementary school is an example of what many of the schools during the late 1900’s were designed to be like. The school is divided into two wings, one for grades K-2 and the other for grades 3-5. In total there are 46 classrooms and of those classrooms 18 of the 46 do not have any windows. (American, 1996) Of the roughly 2/3 of classrooms that do have windows they have small windows along one wall of the classroom. Rather than a focus on windows and other beneficial features, the design was focused on creating “academic neighborhoods” and a focus on technology that was state of the art at the time. (American, 1996)

Figure 2.21. “Amelia Elementary School Interior” (American, 1996)

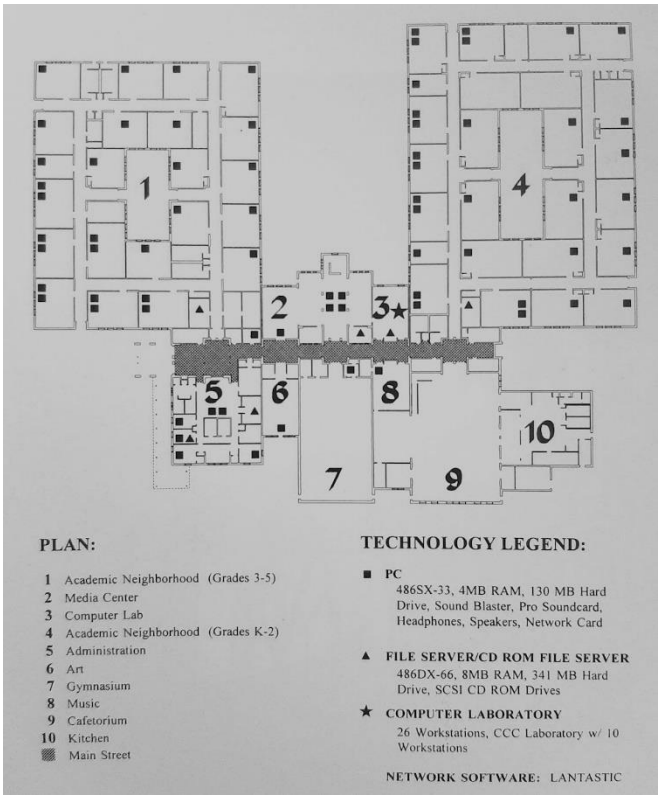

Figure 2.22. “Amelia Elementary School Interior” (American, 1996)

The school now struggles in comparison to some of the other schools in the district and has lower math, reading and science proficiency levels. The lowest being reading with only 48% proficiency compared to the state average of 73% proficiency. (Amelia County, 2023) One reason for this difference could be the lack of windows, as studies have shown a significant increase in test scores in classrooms that have windows compared to classrooms that do not. (Heschong et al., 2002)

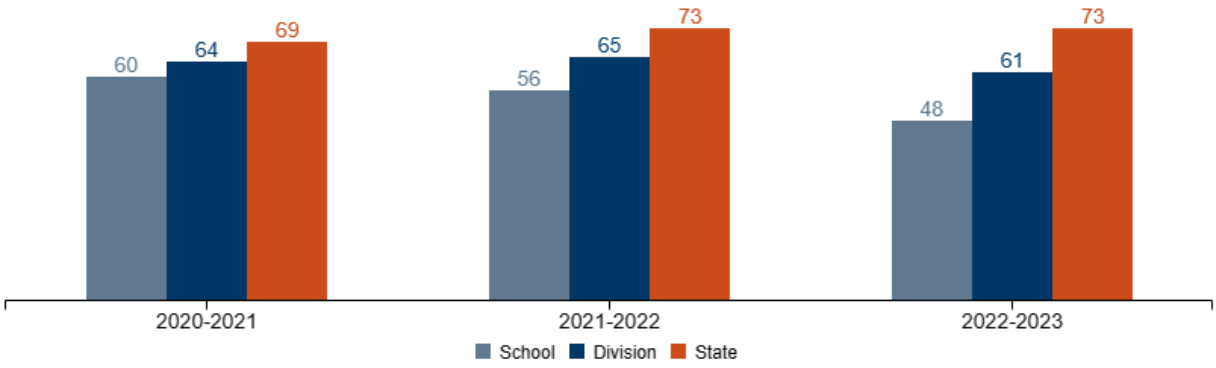

Figure 2.23. “Amelia Elementary School Reading Proficiency” (Amelia County, 2023)

2.3. Background Concepts

A school has many different purposes and social concepts such as being a building, an education, an institution, and a community. Understanding each of these and how a school can be a vessel of each is important to better understand how students use the space. Schools are dynamic spaces with a variety of purposes. This means that to design a school it is important to consider all factors that may be a purpose or influence at the school.

2.3.1. School as a Building

School buildings have changed over time but are usually comprised of primary classrooms where students spend most of their time learning with one teacher, and secondary spaces such as gyms, computer labs, libraries, art room, etc. where additional learning or wellness activities are performed, often with a specialist teacher proficient in a certain area of teaching. Schools are often set up in sections by grade level and education is generally separated into 3 schools, elementary, middle, and high school in the United States.

2.3.2. School as an Education

Education in the United States is highly valued and 86% of students graduate with their high school diploma in 2018-2019. (Irwin et al., n.d.) Schools are a place for learning valuable information to function as a member of society and have become a very linear systematic way of teaching with guidelines and standards that need to be met along the way. Education follows state testing to ensure students are learning and progressing to allow them to continue in the system or receive more help to catch up. Dropout rates have steadily been decreasing as it becomes more competitive to stay above poverty without the education credentials to receive a well-paying job.

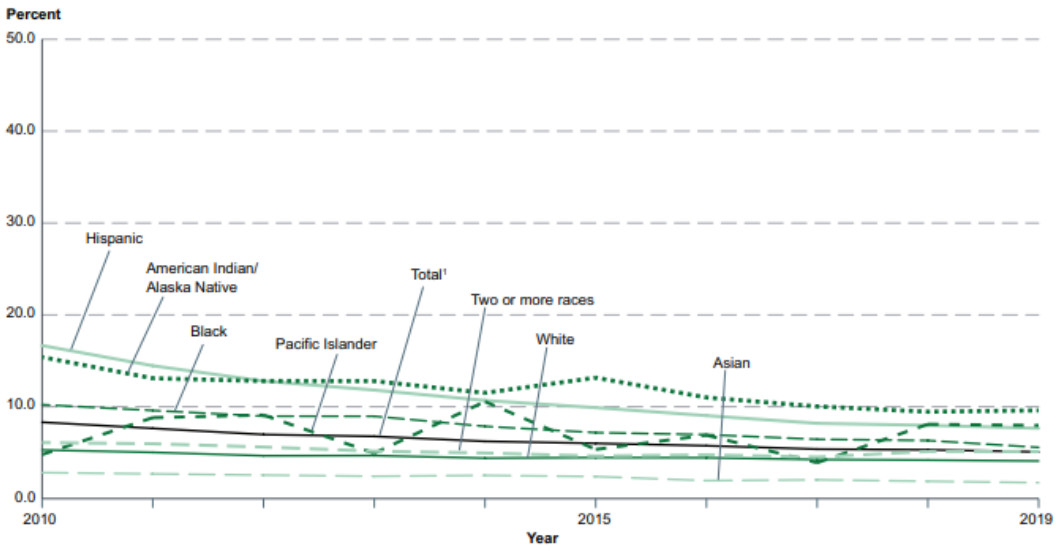

Figure 2.24. “United States Dropout Rate” (Irwin et al., n.d.)

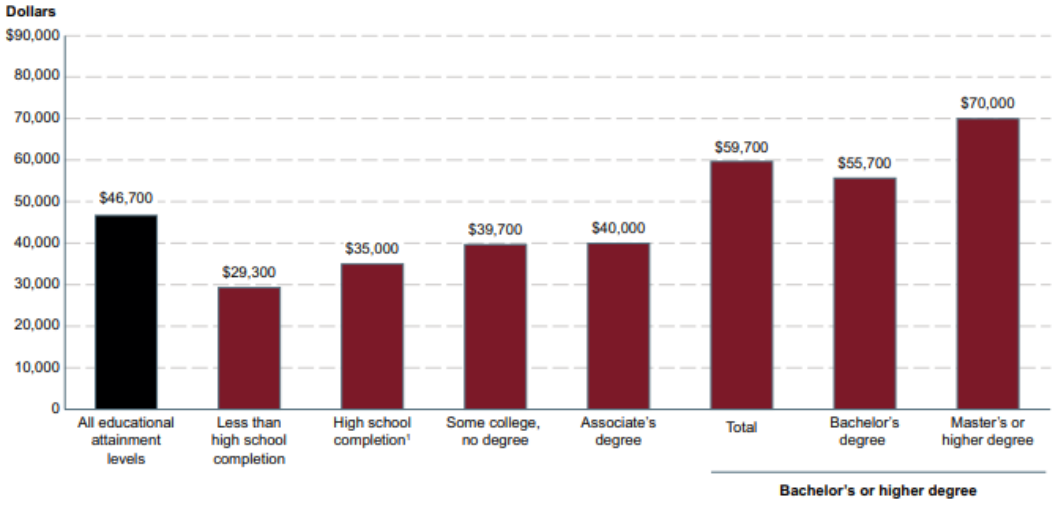

Figure 2.25. “United States Median Annual Earnings Age 25-34” (Irwin et al., n.d.)

2.3.3. School as an Institution

Schools are often categorized as public or private schools. The focus of research will predominantly focus on public schools since all students are granted access to a public K-12

education, whereas private schools are often expensive and not available to the common student. Public schools are divided into districts run often by elected schoolboards and are regulated predominantly by the state they are in.

2.3.3.1. Government

Public schools are funded by state, local and federal governments and the government decides most of the educational standards and curriculum to adhere to. According to the national center for education statistics, “In school year 2017-18, elementary and secondary public-school revenues totaled $761 billion in constant 2019-20 dollars. Of this total, 8 percent, or $59 billion, were from federal sources; 47 percent, or $357 billion, were from state sources; and 45 percent, or $345 billion, were from local sources.”. (Irwin et al., n.d.) This shows the significant amount of money it costs to run the education system, with a cost of around $14,891 per student enrolled in the United States. (Irwin et al., n.d.)

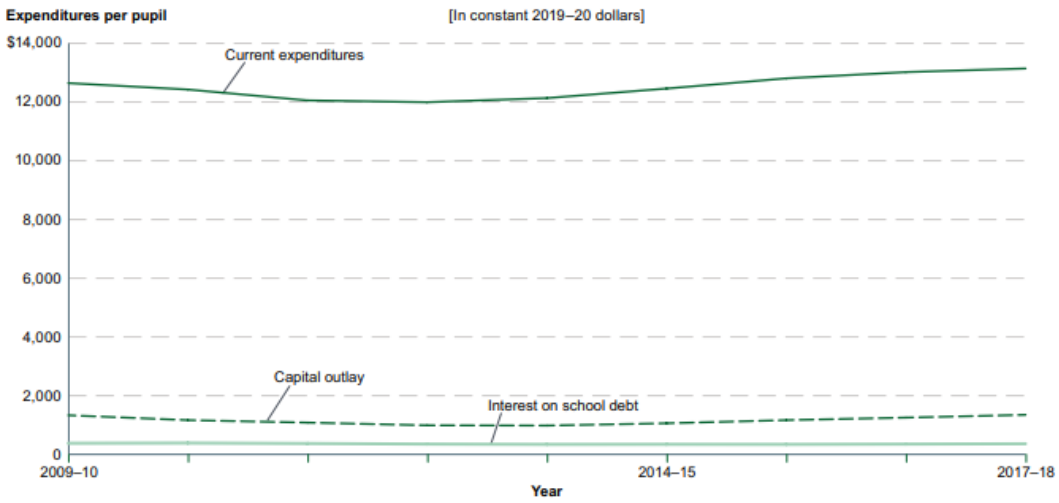

Figure 2.26. “Average Expenditures Per Pupil” (Irwin et al., n.d.)

2.3.4. School as a Community

Schools are often not only used for education but also for extra-curricular activities and events in the community. Schools often provide space for athletics, clubs, and community education and host a variety of events. Many of the spaces within the school could be better utilized but are designed for a very specific part of the education process and often become outdated, need to adapt to new standards, or are unusable for other events. Creating spaces for the community to gather outside of school hours can not only continue the growth of the community of the students, but the public community as well.

3. RESEARCH & METHODOLOGY

Research will focus on the impact of daylighting, outdoor learning environments, windows, alternative learning, and a variety of sustainable architecture factors. Research explores arguments for and against a variety of research topics and focuses on the education and economic side of school buildings. To better understand the scope of research and applicability to the site, the site will be analyzed on local demographics and existing problems.

3.1. Site Location

The site is in the United States of America, the focus of research and an education system that has been declining statistically compared to other international education systems. The region the site is in is the Midwest. The Midwest has had some of the largest relative increases in learning disabilities such as ADHD and is an area where educational architecture has not been making much progress. (Akinbami, 2011) Minnesota has been selected as the state for site location due to its diverse climate and need for new school proposals.

3.2. Site Demographics

The proposed site is located 15 min from 10 similarly sized elementary schools within the Minneapolis public school district and allows for the roughly 10% of students with learning disabilities at these schools to get an alternative education in the area. The proposed site is in Uptown, a neighborhood in Minneapolis, that is statistically higher in crime. However, the school is located near Lake of the Isles and is integrated into the residential and recreational areas of the neighborhood to ensure safety and security to students. The site is on a one-way,

limiting traffic/risk of students being hit and has access to many trails, water, woods, and outdoor environments not normally found in an urban environment, that are suitable for outdoor learning.

3.3. Specific Site

The proposed site is currently an empty lot on the corner of West 28th Street and West Lake of the Isles Parkway. 2802 W Lake of the Isles Pkwy, Minneapolis, MN 55416 is the street address. The site is currently owned by the City of Minneapolis parks and is an empty field with trees to the east and west, a bike trail to the south and the lake and road to the north. This site was chosen due to the access to outdoor amenities, being within 15 min. of 10 schools in the district, and its seclusion from higher crime areas. The site is currently occasionally used for events such as small concerts, markets, and seasonal activities but remains underutilized for most of the year.

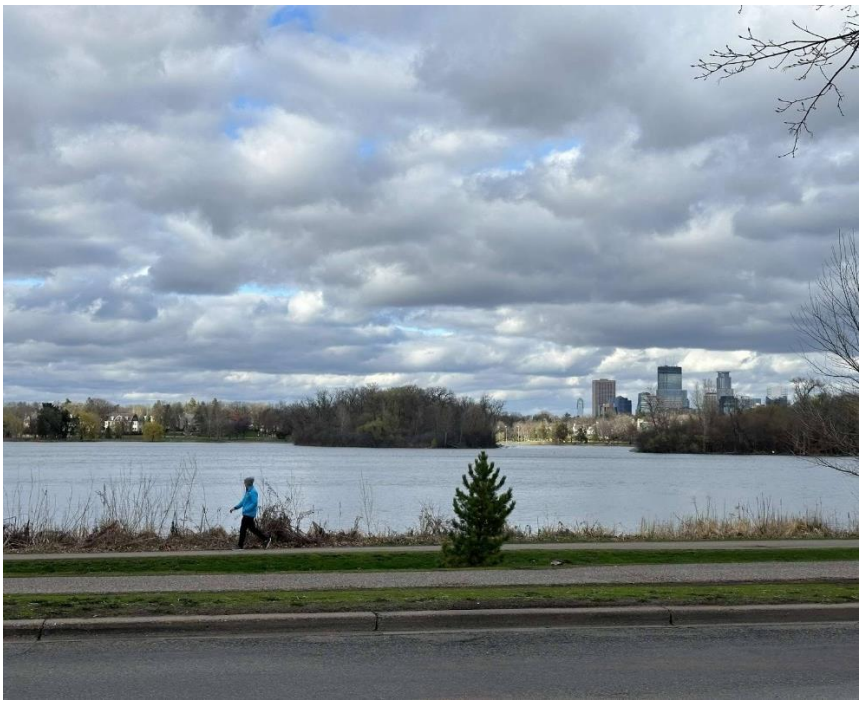

Figure 3.1. Current Site View

Figure 3.2. Current Site

Figure 3.3. Current Site Road

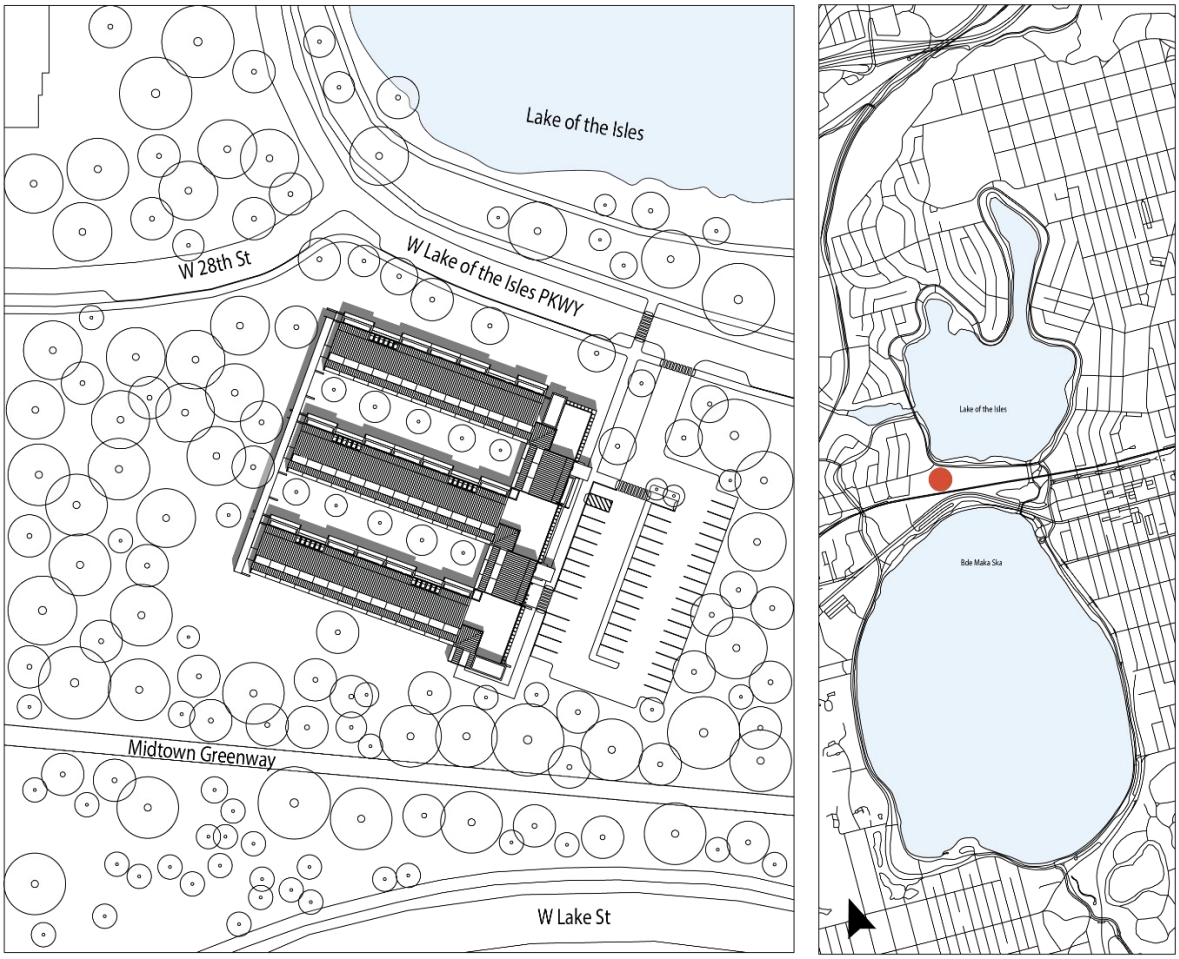

Figure 3.4. Site Plan

3.4. Research

The research investigates a variety of architecture, educational and behavioral topics related to new alternative learning environments and what has been proven beneficial for learning. Research in the past as well as current studies set a baseline for where the educational environment has been, how it got to that conclusion, and where it would be beneficial to trend.

3.4.1. The Effect of Windowless Classrooms, 1965

Figure 3.5. “Hoover School Windows and No Windows” (University of Michigan, 1965)

In 1965 University of Michigan researchers conducted a study that claimed windowless classrooms were better for education without conclusive results, backed by claims such as windowless is better because there is more space to hang educational material on the walls. (University of Michigan, 1965) The University of Michigan’s study “The Effect of Windowless Classrooms on Elementary School Students” had a small sample size of 1 class of each grade kindergarten through fourth grade, at 2 test schools over the course of 3 years. (University of Michigan, 1965) 1 test school was the control, Mann, and the other was the test school, Hoover.

Table 1. HOOVER SCHOOL ANNUAL ENROLLMENTS

	Kindergarten		Grade 1	Grade 2	Grade 3	Total School Enrollment
	a.m.	p.m.				
Stage 1, With Windows (1961-62)	21	20	30	29	24	124
Stage 2, Windows Removed (1962-63)	29	30	24	23	26	132
Stage 3, Windows Restored (1963-64)	36	27	33	18	23	137

Figure 3.6. “Hoover Enrollment” (University of Michigan, 1965)

The results were rather inconclusive and too small for a study, resulting in the authors making assumptions and interpretations of the results for themselves. Some of these assumptions were that windows are not needed because there is more space for educational material and uses for the walls, even though the trend of accessories and positive response to them increased through the whole study, with or without windows. (University of Michigan, 1965) The results of windows specifically trended opposite of the classroom reaching inconclusive results in such a small sample.

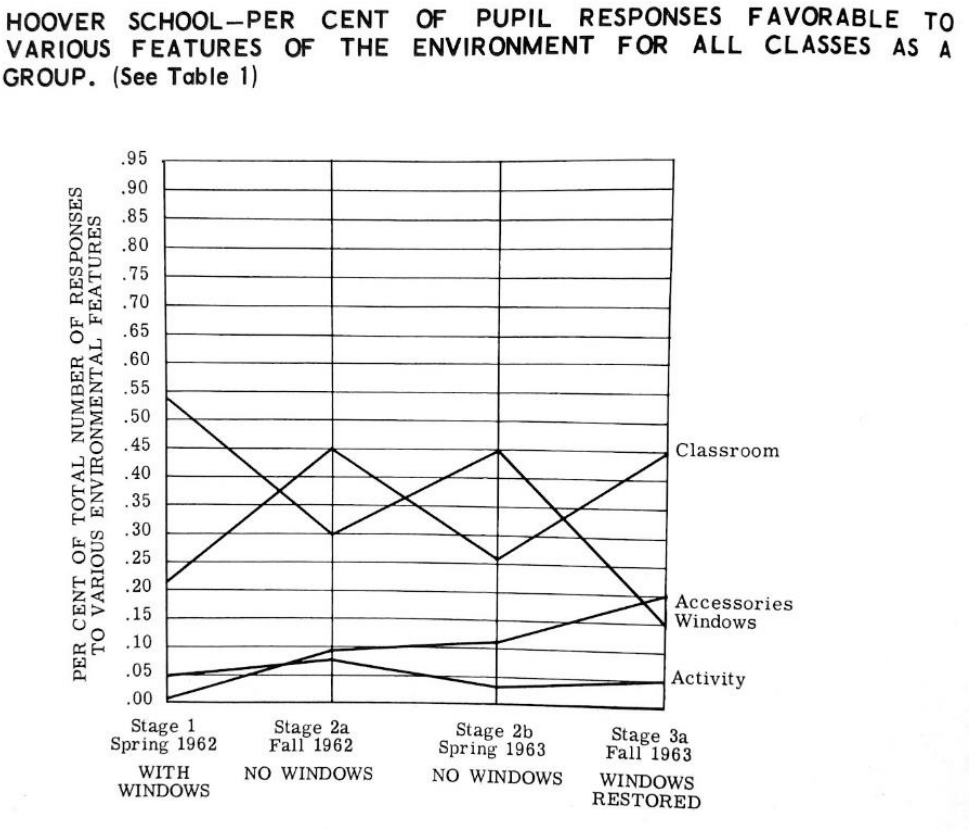

Figure 3.7. “Hoover Favorable Responses” (University of Michigan, 1965)

This thought process and that windows were a distraction led to many schools being built with windowless or minimal windows in classrooms throughout the end of the late 1900’s and led to rises in learning disabilities such as ADHD.

3.4.2. Daylighting Impacts on Human Performance in School, 2002

In 2002 a study was done by Lisa Heschong. The study acknowledged the change of views in the 1960’s and how affordability took priority throughout the end of the century instead of educational advantages. (Heschong et al., 2002) Heschong claimed in the mid 1960’s

“Educational theorists argued that a more flexible arrangement of open classrooms, grouped in large open-plan buildings, would encourage team-teaching and creative learning.” While “Construction economists argued that schools could be built more inexpensively on smaller sites if the classrooms could be grouped together in modules, without constraints on solar orientation.” (Heschong et al., 2002) This construction thought process and studies like the one at University of Michigan led to the results of educational architecture seen in the late 1900’s. Poorly sunlit and cheaply built structures focused on affordability over education. Heschong’s extensive research showed how this negatively impacted learning. For her research three school districts were chosen for her study: Orange County CA, Seattle WA, and Fort Collins CO. Each of the districts had 6,000 to 8,000 students that were included in the study. (Heschong et al., 2002) This is a drastic and intense difference compared to studies done prior with only a few hundred students.

Window Code	Grade	Typical condition
0	None	None
1	Bad	One small window
2	Poor	A few small windows, tint
3	Average	Modest windows, and/or heavy tint
4	Good	Large windows, light tint or clear
5	Excellent	Large windows on two sides

Figure 3.8. “Window Codes” (Heschong et al., 2002)

The study focused on windows, daylighting and 2 types of skylights and ranked existing classrooms based on how these features are affecting the learning environment. The classrooms were categorized from 0- 5 in a window code on their amount of windows to control the variables of the study. Once the classrooms are categorized, they then looked at how the testing results were depending on the lighting and windows.

Figure 3.9. “Code 1 (Left)” & “Code 5 (Right)” (Heschong et al., 2002)

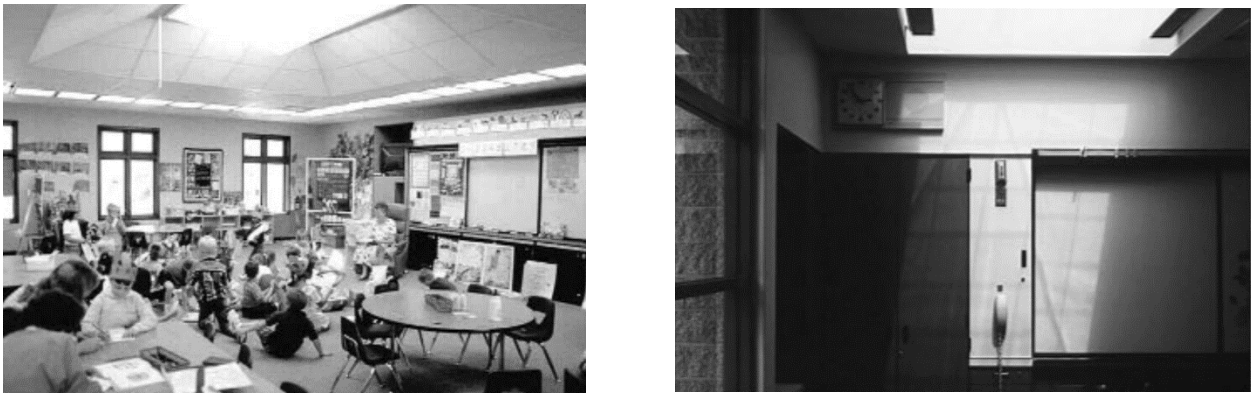

Figure 3.10. “Skylight Type A (Left)” & “Type B (Right)” (Heschong et al., 2002)

The results showed daylighting had a significant effect on education. In the California schools it was shown that “The classrooms with the highest Window Code were found to be associated with 15 to 23 percent faster rate of improvement over a one year period when compared to classrooms with the lowest Window Code.” (Heschong et al., 2002) These results were similar in daylighting with 20-26% improvement and skylight type A with 19-20% improvement. (Heschong et al., 2002) These results show the importance of including daylighting and windows into classrooms and the positive effects. During the research they also took note of which classrooms had operable windows versus non-operable and concluded that “operable windows were found to be associated with 7 to 8 percent faster improvement in three out of four cases, when compared to classrooms with fixed windows.” (Heschong et al., 2002) The only negative outcome of daylighting in the California schools studied was classrooms that had Skylight type B. Skylight type B had high daylighting that lacked diffusion that would result in glare and thermal discomfort. This didn’t affect math testing but had a 21% decrease in reading test scores. (Heschong et al., 2002)

Capistrano	Analysis Results				Percentage Effect	
NEA Core Level Tests Range: -29 to +79	Difference in Average Test Improvement (normalized RIT points)		Statistical Certainty		Difference as a % of District Average Improvement	
Change, Fall to Spring	Reading	Math	Reading	Math	Reading	Math
Model 1						
Daylight, Min. to Max.	2.8	2.3	99.9	99.9	26%	20%
Operable Windows	0.8	-	99.8	n/s	7%	-
Model 2						
Windows, Min. to Max.	2.4	1.7	99.9	99.9	23%	15%
Skylight A	2.0	2.3	99.7	99.9	19%	20%
Skylight B	-2.2	-	94.9	n/s	-21%	-
Operable Windows	0.9	0.8	99.6	99.9	8%	7%

Figure 3.11. “California Results Summary” (Heschong et al., 2002)

The results of Seattle and Fort Collins had similar results in that both found that daylighting had a positive impact on learning. These studies did not collect as much data as the California study and were in different environmental areas that may have impacted results. Heschong's research found that in Seattle, "All other things being equal, students in classrooms with the largest window area, or the most daylight, were found to be testing 9 to 15 percent higher than those students in classrooms with the least window area or daylighting. A 6 to 7 percent effect is observed for the skylit classrooms." (Heschong et al., 2002) They also found similar results in Fort Collins with a 14-18 percent improvement in the most daylit classrooms. (Heschong et al., 2002)

Seattle	**Analysis Results**				**Percentage Effect**	
ITBS Iowa Test of Basic Skills NCE Scale 1-99	Difference in Average Test Scores (NCE percentage points)		Statistical Certainty		Difference as a % of District Average Score	
Spring Scores	Reading	Math	Reading	Math	Reading	Math
Model 1						
Daylight, Min. to Max.	7.5	5.6	99.9%	99.9%	13%	9%
Model 2						
Windows, Min. to Max.	7.7	8.7	99.9%	99.9%	13%	15%
Skylights, Min. to Max.	3.9	3.4	99.9%	99.8%	7%	6%

Figure 3.12. "Seattle Results Summary" (Heschong et al., 2002)

Fort Collins	**Analysis Results**				**Percentage Effect**	
NEA Core Level Tests Normalized Scale 1-99	Difference in Average Test Scores (normalized RIT points)		Statistical Certainty		Difference as a % of District Average Score	
Spring Scores	Reading	Math	Reading	Math	Reading	Math
Model 1						
Daylight, Min. to Max.	3.8	3.4	99.9%	99.9%	7%	7%
Model 2						
Windows, Min. to Max.	10.2	7.0	99.9%	99.9%	18%	14%
Skylight Monitor	-	1.6	n/s	99.7%	-	3%

Figure 3.13. "Fort Collins Results Summary" (Heschong et al., 2002)

3.4.3. Windows & Daylighting

Windows have been shown to significantly increase the learning environment in educational setting with test scores backing up the results. Studies done by Heschong in 2002 had a sample of 21,000 students and controlled standard of variables, compared to the research with a sample of a few hundred students, done at the University of Michigan in 1965. (Heschong et al., 2002)(University of Michigan, 1965) While the University of Michigan's results were inconclusive an inferential conclusion was made that windows have neither a negative or positive effect on learning but that no windows does provide more space to hang educational materials on the walls.(University of Michigan, 1965) This was later proven to not be the case when the study conducted by Heschong, in 2002, showed definitively that windows and daylighting were very beneficial to improving learning and test scores. When possible, the maximum amount of windows should be used in exception to skylights that provide un-diffused direct sunlight, as these skylights create uncomfortable lighting and glare for reading. (Heschong et al., 2002)

3.4.4. Outdoor Learning

Outdoor learning seems to be a relatively new concept but according to Jucker, "Outdoor learning can be traced back at least to World War II" yet has very little enactment into the education system. (Jucker & von Au, 2022) Learning is not a one size fits all process and using all your senses and being outdoors expands the ability for many different types of learners to learn. Jucker also noted "Learning that activates as many senses as possible (seeing, smelling, touching, hearing, moving, …), which takes place in dynamic, real-world learning environments, and which demands social interaction and self-guided involvement of the learners, is likely to be

very effective." (Jucker & von Au, 2022) Some schools in the Midwest United States region are starting to better test this with the introduction of optional outdoor learning classrooms for K-5 students, with positive results, but outdoor learning has not been widespread. Besides just being outdoors, research found that long term recall of things learned is much better when people are moving or can use all their senses when learning. (Jucker & von Au, 2022) This is one of the key points of outdoor learning and a way that students can be involved and more exploratory in their own learning experience. Outdoor learning is one of the few learning styles that is overall effective for most students, including those with learning disabilities, that often struggle the most when learning in traditional classrooms. In an age of ever-increasing technology and indoor teaching a combination of indoor, using technology learning, and outdoor, in nature learning, would be highly beneficial. Besides learning benefits, outdoor learning students have been found to have "rejuvenating effects on attention… stress relief… self-discipline… motivation, enjoyment, and engagement… and higher physical activity and fitness". (Jucker & von Au, 2022) Outdoor learning leads to happier and healthier students as well as increased learning potential.

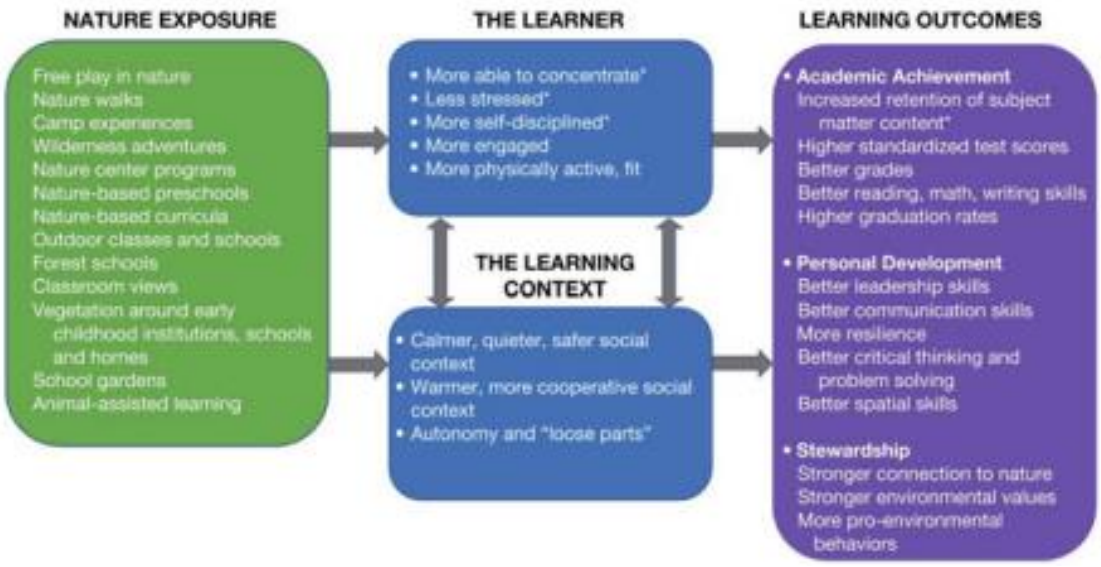

Figure 3.14. “Outdoor Learning Outcomes” (Jucker & von Au, 2022)

3.4.5. Sustainability

Many sustainable features are beneficial to add to school design including, passive heating and ventilation, water collection, green roofs, natural materials, solar panels and daylighting. Many of these features are well known to benefit any building typology and create a healthier environment for occupants. Creating schools with sustainable features will be beneficial to the learning environment and it is important to make note of when developing a school design. Sustainability is often overlooked in school design due to budgets and spending by local and state governments, but as more states pass laws requiring sustainable features, schools will soon be expected to adhere to those standards as well.

Figure 3.15. “Passive Ventilation System” (Ford, 2007)

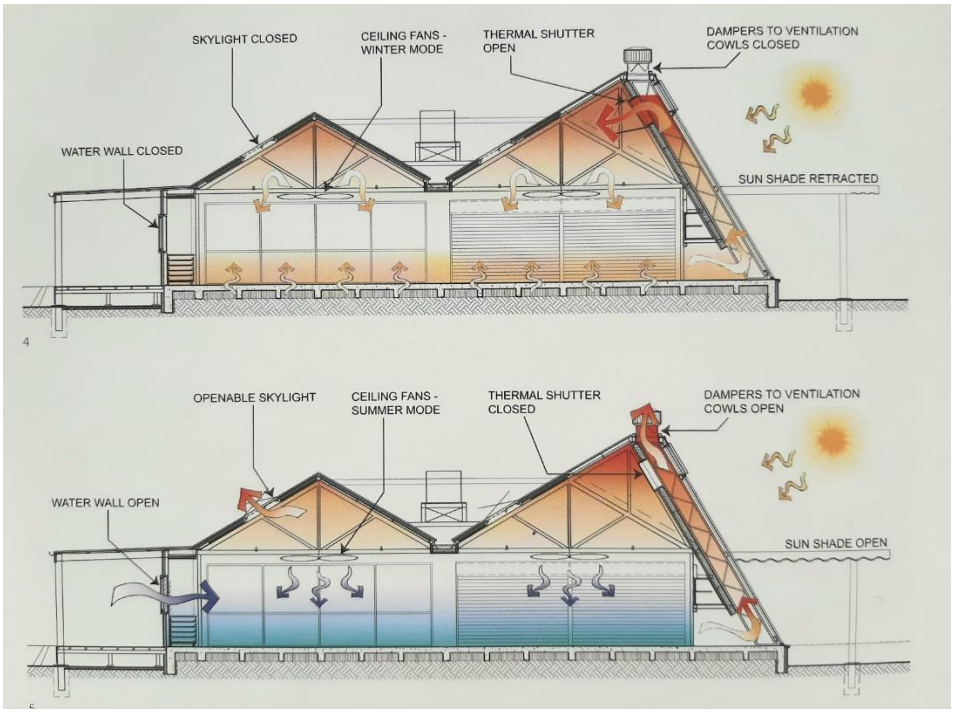

Figure 3.16. “Passive System Diagram” (Ford, 2007)

3.5. Precedent Case Studies

As current research becomes more widely known and begins to be integrated into design there will be a rise in educational facilities that create good environments for learning. Some recent educational facilities are breaking the mold and mindset of the late 1900's and integrating beneficial design strategies into the architecture. These precedent case studies show the effects of daylighting, outdoor learning, and other sustainable practices, as well as how they create dynamic engaging learning environments. These precedent studies show that creating schools that have a positive impact, rather than neutral or negative, is possible and needed to combat the problems of education in the United States.

3.5.1. Case Study 1 : 2012 Logan Center for the Arts - Tod Williams and Billie Tsien Architects

The University of Chicago's Logan Center for the Arts was built in 2012. Focused on sustainability and daylighting, the center is pursuing LEED Certification and is an example of an educational facility leading the way in future school design. Logan Center for the Arts is home to the visual arts program, which has studios and workshops on the lower levels. The studios have skylights that offer natural daylight down into the space and provide a well-lit and encouraging bright working environment for the artists.

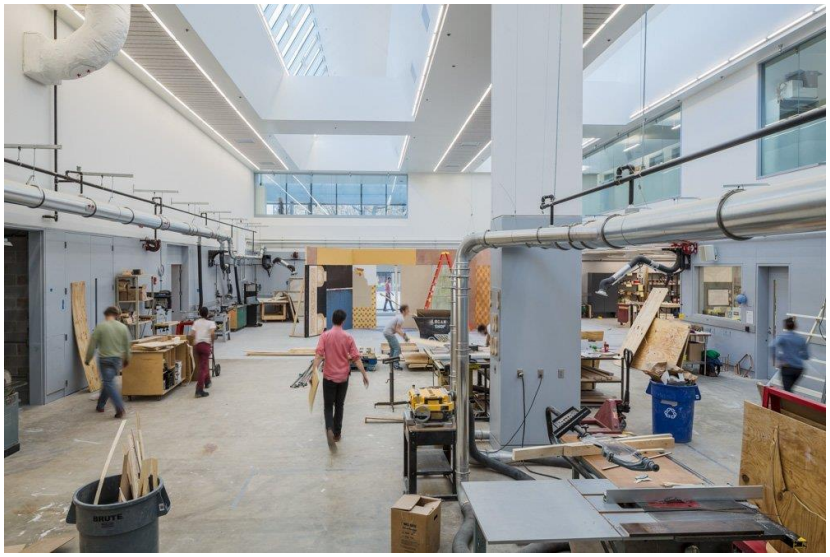

Figure 3.17. “Logan Center Interior” (Logan Center, 2012).

The Architects Tod Williams and Bille Tsien described their vision as “The idea of the long, low, skylit building of studios and theaters, and the tower of the arts came from imagining the flat prairies of the Midwest and the great towers of Chicago.” (Logan Center, 2012) This vision can be seen in not only the design but also the sustainable features.

Figure 3.18. “Logan Center Exterior” (Logan Center, 2012)

The Logan Centers roof has a variety of sustainable and positive educational features including green roofs, solar panels, regionally sourced materials, and skylights. (Logan Center, 2012) While in an urban setting, the Logan Center is able to appear from within that it is somewhere in nature. Its sustainable strategies make the users and students in the space feel as if they are in a different environment that is much more conducive to learning than an urban environment. These strategies and the use of daylighting show that this is a building that is a good precedent example of how designing for students and with nature can be beneficial to learning outcomes.

Figure 3.19. “Logan Center Roof” (Logan Center, 2012)

3.5.2. Case Study 2 : 2021 Life Campus - Vilhelm Lauritzen Architects

Built in 2021, the Life Campus, designed by Vilhelm Lauritzen Architects, exhibits many of the beneficial researched strategies of a positive educational facility. According to the architects, life campus is located on old hunting grounds near Copenhagen, which is full of

nature. (LIFE Campus, 2023) This blends the STEM focus of the institution with integration of nature and outdoor environments. The building is also built with a combination of natural and manufactured materials with a focus on the 96 raw oak columns designed to look like “DNA and Fibonacci” according to the architects. (LIFE Campus, 2023) The exterior has trees and natural grasses instead of the common manicured lawn of most educational facilities and allows students to be enveloped by the natural environment.

Figure 3.20. “Life Campus Exterior” (LIFE Campus, 2023)

The interior of the building was designed similarly with a focus on views to the outdoors, well daylit environments, and adaptability. The architects also strived to invoke active learning by providing “Changing spatial experiences with raw materials, visible piping and technical

installations.” (LIFE Campus, 2023) The exposed innerworkings of the building provide active STEM examples that the students can view and touch to learn.

Figure 3.21. “Life Campus Lab” (LIFE Campus, 2023)

Figure 3.22. “Life Campus Interior” (LIFE Campus, 2023)

The Life Campus is designed to be able to change as different things need to be studied there and the labs can transform to a new desired space in the future. Several positive strategies shown by the building floorplans are classrooms located on the edge of the building providing views and daylighting, and support spaces such as the 360-degree auditorium, that exclude windows, placed on the interior. The educational facility also has “learning gardens Life Arboretum and Life Orchard with a vast variety of trees” according to the architect. (LIFE Campus, 2023)

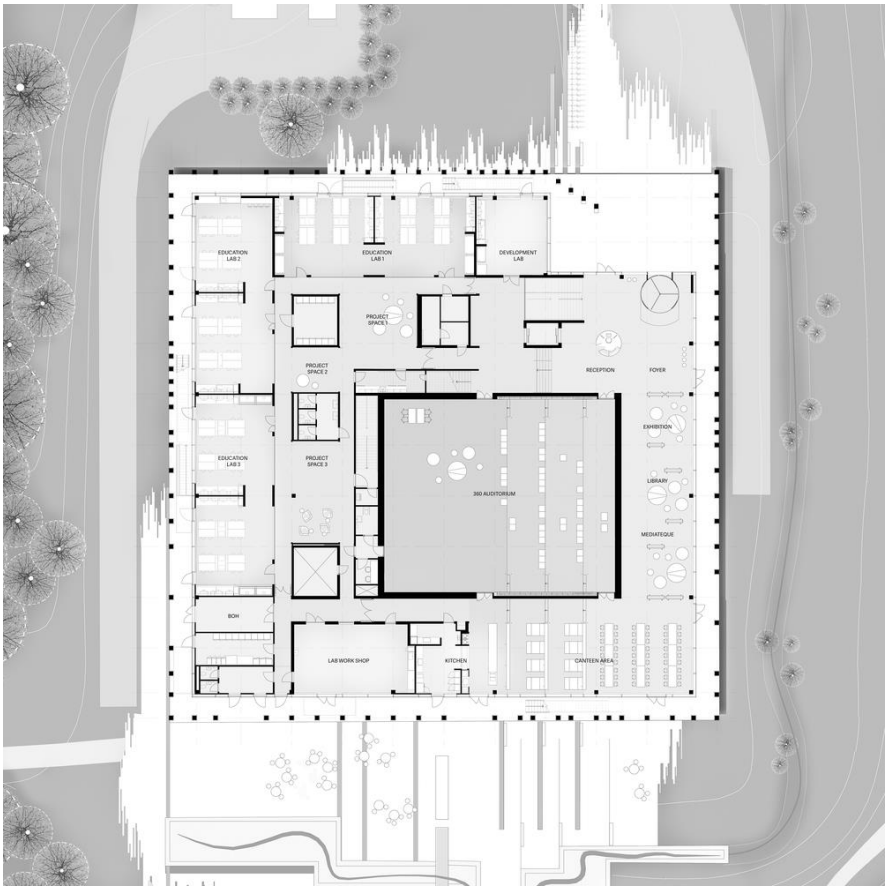

Figure 3.23. “Life Campus Ground Level” (LIFE Campus, 2023)

The proximity and abundance of nature for this educational facility shows the use of beneficial environmental strategies and why this case study is a precedent of what a positive future education can be.

3.5.3. Case study 3 : 2023 Lovell International School - Plan Architect

Lovell International school in Pattaya City, Thailand shows how designing with nature can create positive learning environments and create an environment that is appealing to students. The Architect, Plan Architect, said that Lovell International School is a place “Where children can play and learn among the trees.” (Lovell, n.d.) When designing the school, they built around the existing full-grown trees to create a feeling of being enveloped by the forest.

Figure 3.24. “Lovell School Aerial” (Lovell, n.d.)

Figure 3.25. “Lovell School Lower Level” (Lovell, n.d.)

The design of the lower level took a curvilinear path to avoid trees, create a roof deck, and create greenery filled courtyards to investigate. (Lovell, n.d.) This creates courtyards for each area of the building and outdoor learning space for the students. Some of the learning spaces include “green space for learning about agriculture and waste recycling” said Plan Architect’s. (Lovell, n.d.)

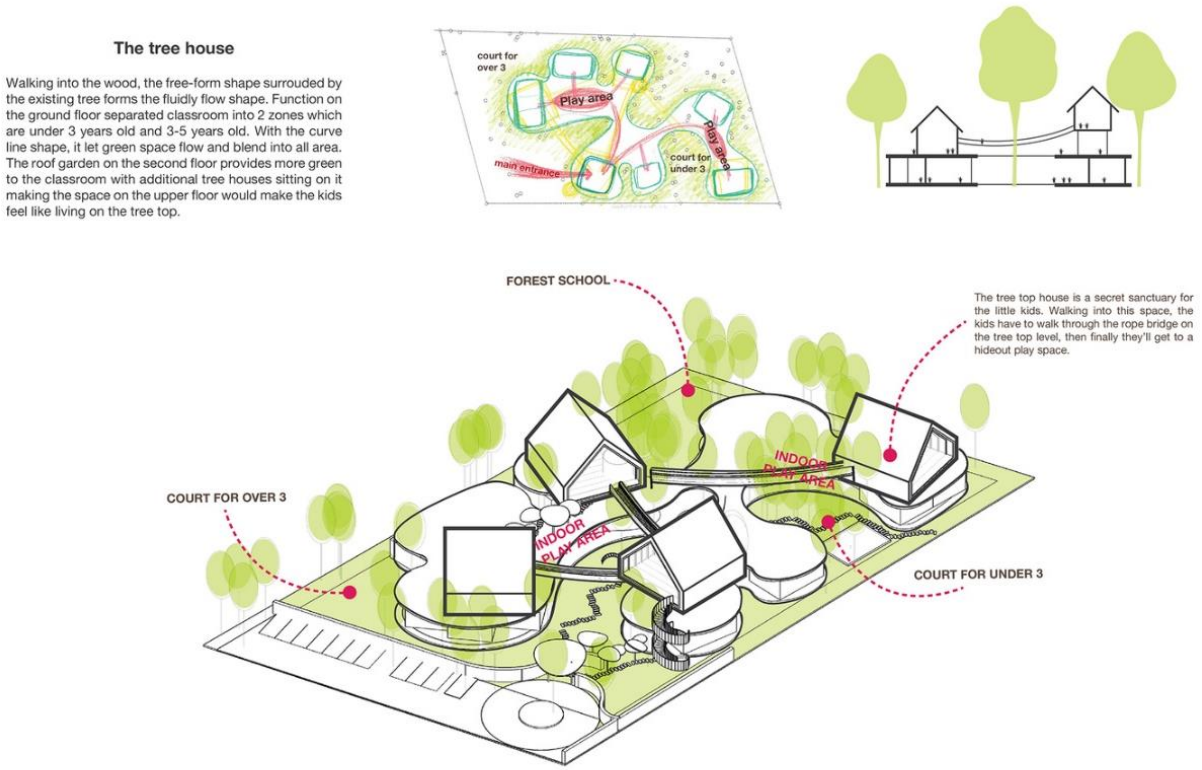

Figure 3.26. “Lovell School Diagram” (Lovell, n.d.)

The school’s interior is designed with two materials, wood, and white color, depending on the use. (Lovell, n.d.) All the halls and indoor play spaces are wood with the idea of making the rooms feel like they are nestled into the woods. While all the classrooms are painted white to maximize the brightness and daylighting for a positive learning outcome. This and the focus of integrating the outdoors/nature into the school create a good example of a learning environment that improves the future of education.

Figure 3.27. “Lovell School Hall” (Lovell, n.d.)

Figure 3.28. “Lovell School Classroom” (Lovell, n.d.)

3.6. Space Program

When integrating a school onto the site the space must maximize views and daylighting to all classrooms. The space should aim to have 360 students grades K-5 with roughly 3 classes of 20 students per grade, or 60 students per grade. The space would ideally be 2 stories with classrooms on the lower level with support spaces above. The total number of classrooms needed is 18 with an additional 3 being for special needs. The school will also need a cafeteria and kitchen, science labs, outdoor classrooms, administration space, staff workrooms, conference rooms, restrooms, a large lobby/gathering space, and mechanical spaces. Some spaces this school can overlook are gym and athletic spaces as the learning model for this school is intended to be outdoor focused, as well as the schools bussing students to this school have those facilities already.

4. RESULTS AND CONCLUSIONS

Based on the research, precedent studies and need for an alternative learning environment in the area, a school was designed, implementing the strategies found.

4.1. Project Description

Located across from Lake of the Isles in Minneapolis, Minnesota. This school provides ample amounts of trails, nature, and seclusion, to learn from the outdoors in an urban environment. The site met the need to achieve an alternative learning and outdoor focus K-5 school for students who are negatively impacted by traditional learning practices. Additionally, it is strategically located within 15 minutes of 10 similarly sized K-5 schools within the Minneapolis Public School District. This school is intended as a location for the approximately 10 percent of students with learning challenges such as ADHD, who currently go to the schools nearby, to come to for an education catered towards them, while also providing conducive learning environments.

Urban schools often lack natural light and outdoor spaces, hindering students' cognitive development and well-being. Studies show that exposure to these elements enhances learning outcomes, but schools often prioritize outdated ideas due to economic constraints or lack of awareness. This school challenges those environments and shows the possibility of what an urban school can be.

The school is divided into 3 wings with 2 grades per wing. This allows for interaction within similar grades and allows for the creation of courtyards. The courtyards are a vital part of the design allowing natural light deep into the classrooms as well as providing protected areas to take classes outside. The courtyards also allow every classroom to have access to daylight and views, which has been shown to improve learning based on research.

4.2. Project Objective

This school is designed to make students' learning environment the priority while also being easily constructible and economically feasible. Transforming urban schools by integrating natural light and outdoor spaces can revolutionize learning outcomes and student well-being, challenging outdated norms and paving the way for future success.

4.3. Project Design and Documentation

4.3.1. Boards

The boards are designed to show the general design concepts as well as integrating the key research statistics to show why the problem the proposal addresses is important. The color of the boards, yellow, blue, and red, are used to tie back to the wayfinding colors within the school which were inspired by the colors of the Minneapolis Public School districts logo.

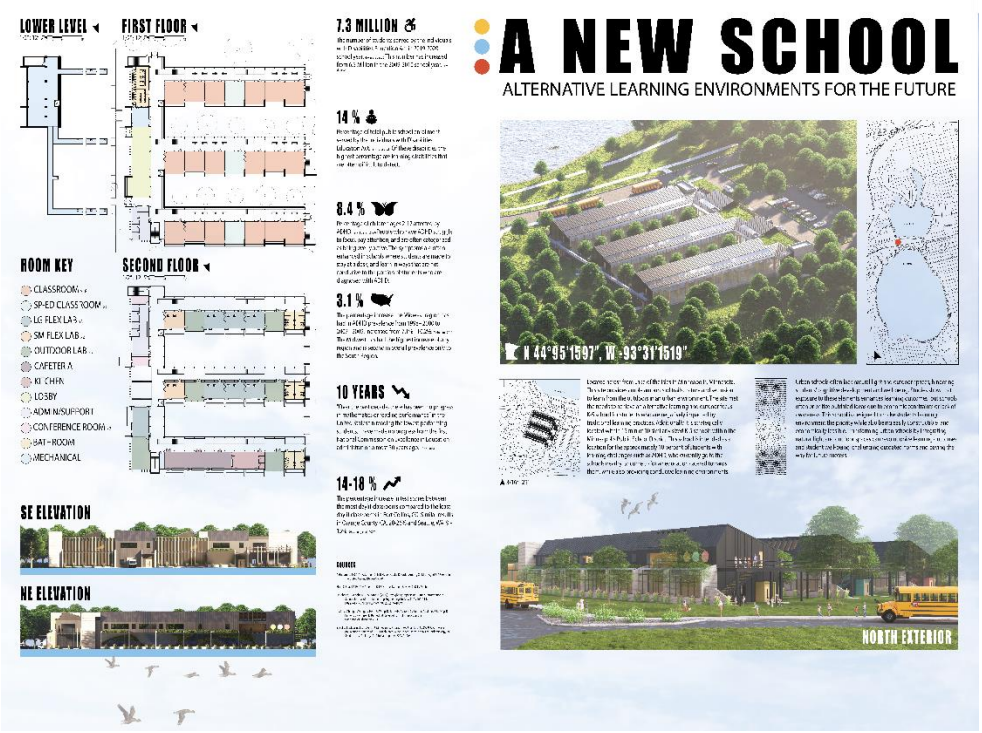

Figure 4.1. Board 1

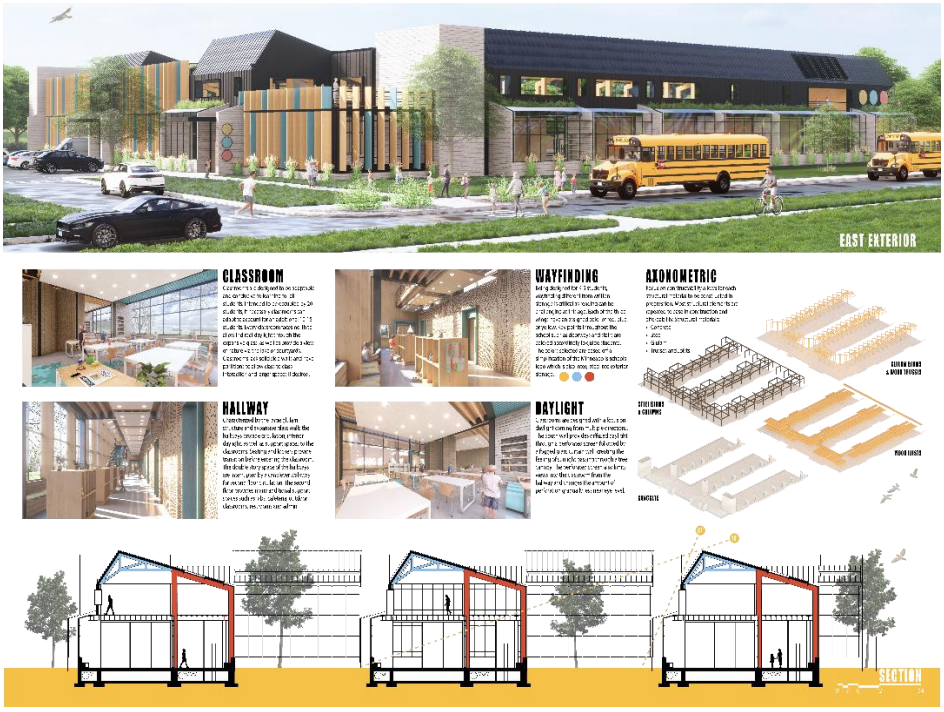

Figure 4.2. Board 2

4.3.2. Site Plan

The site plan shows the schools relation to Lake of the Isles and West Lake of the Ilses Parkway running in front of it. The school has vegetation on three sides and a view of the lake on the north side. The site plan also shows how parking is on the east side next to the administration wing of the school and out of view of the classrooms. There is more parking than required for the amount of faculty with the occupancy of an educational facility, with the intention that there may be an increased faculty to student ratio as an alternative education school. The large site plan also shows how Lake of the Isles, and the site are in a very dense urban environment, yet the site has a lot of key features of a more rural wilderness environment. The current street's parallel parking is integrated into the design as designated bus drop off and pickup. This ensures views of the lake aren't blocked by cars as well as allowing for easier parking for bus drivers, in comparison to trying to park in a narrow parking lot near the building.

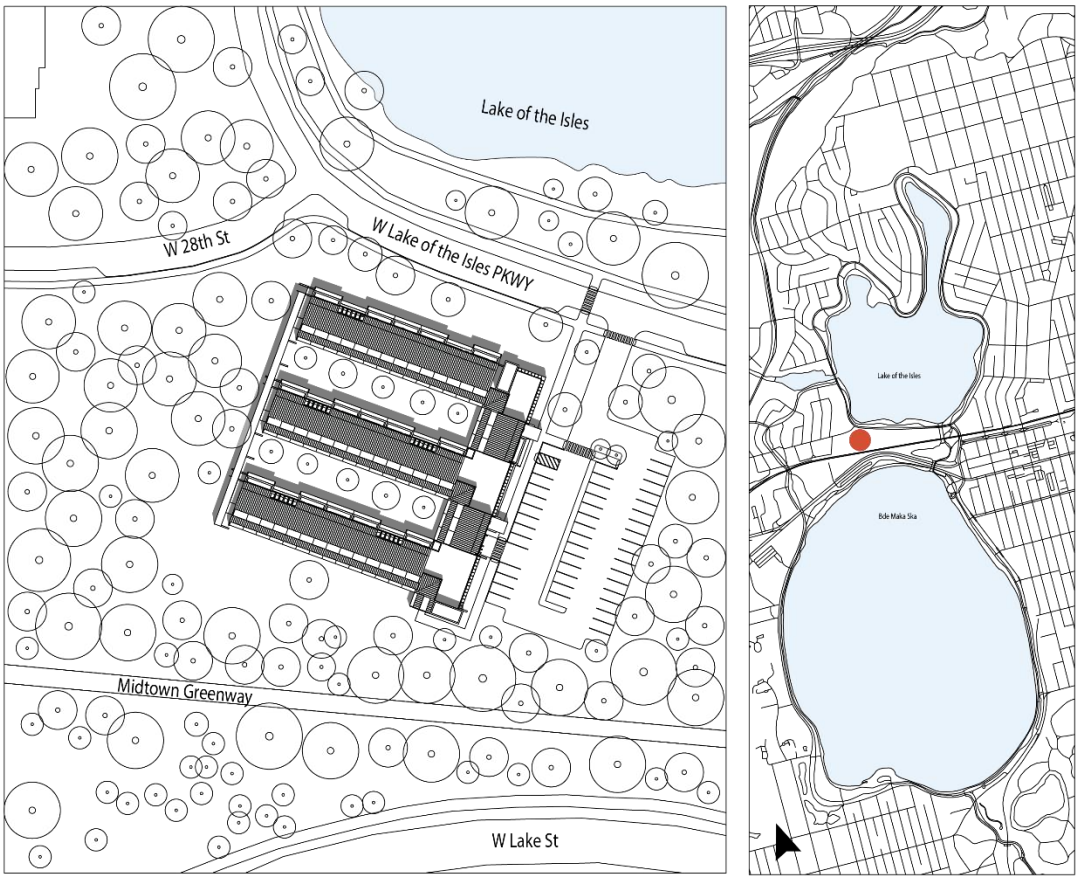

Figure 4.3. Site Plans

4.3.3. Floor Plan

The school has two above ground floors with a smaller lower level for mechanical, feeding each of the wings. There are 18 classrooms, 3 special needs classrooms, 2 small flex labs, 3 large flex labs, 5 outdoor labs, 2 conference rooms, administration, lobby, cafeteria, kitchen, mechanical space and restrooms. All of the class rooms and labs have partitions to expand rooms and encourage inter-grade activities, as well as the ability to share large labs with several classes at a time. The cafeteria can hold 1/3 of the students at a time with the standard that there are several lunch periods rather than everyone eating at once. There are nearly double

the amount of bathrooms than what is required by code due to the potential for class sizes to increase and entire classes using the bathroom at one time when circulating. The hallways have two stairs on either end to allow smooth circulation if multiple classes are transitioning from the first to second floor or vise versa. Because these stairs are not fire stairs two fire stairs are on either end of the administration area and exterior fire stairs are attached to each of the wings with a raised walkway connecting outside allowing fair weather circulation or outdoor access.

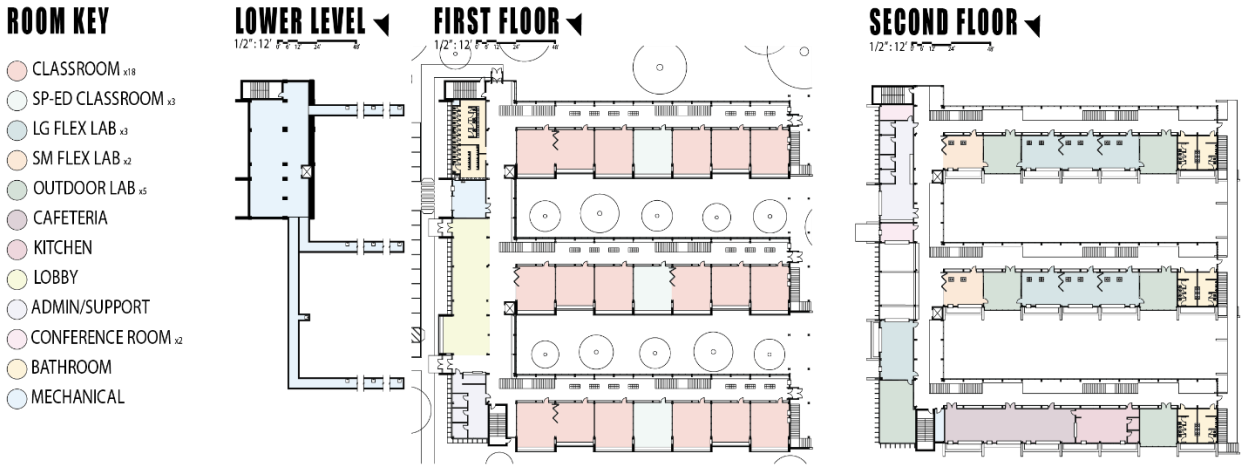

Figure 4.4. Floor Plans

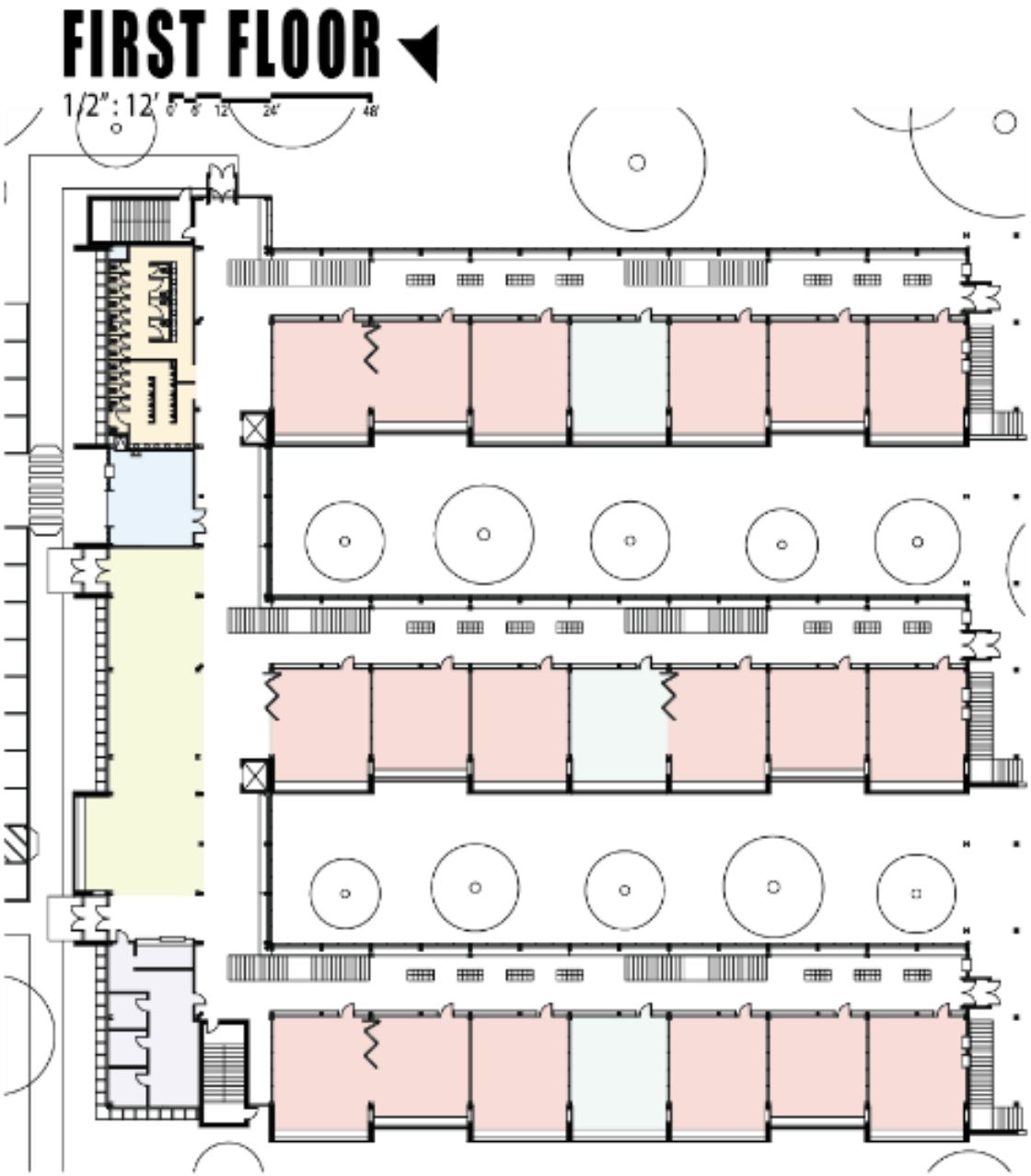

Figure 4.5. First Floor Plan

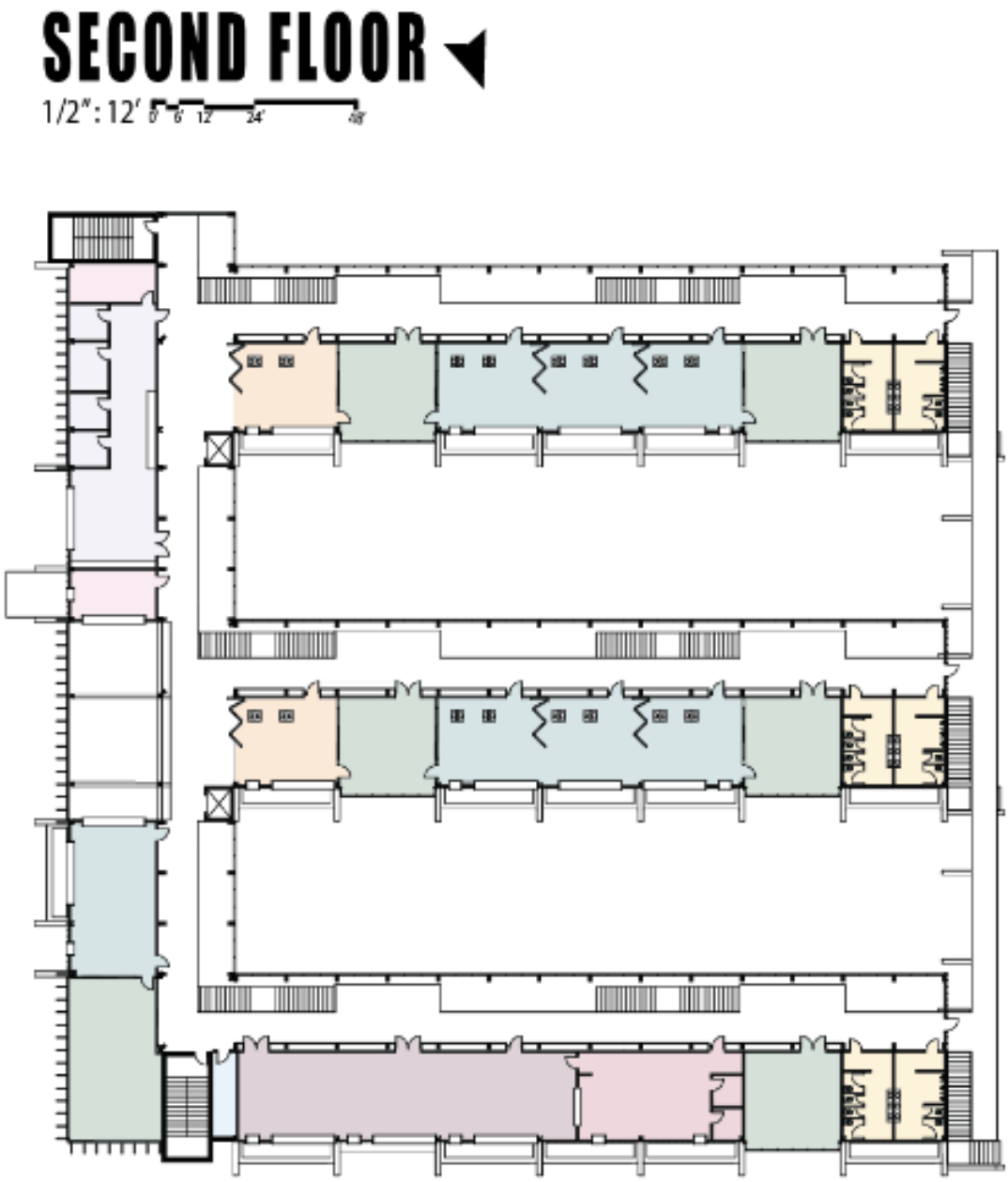

Figure 4.6. Second Floor Plan

4.3.4. Exterior Perspectives

The exterior is made of concrete, glazing, and grooved metal roofing/siding. Facing the parking there are shading devices to block early morning direct sun from administration areas and diffuses it instead. Whereever there are the shading devices the roof above has a green roof system with exception of the North East corner which has an outdoor patio attached to one of the flex labs. The wayfinding colors are also integrated into the wing's side exits and stairs, as well as the signage of the Minneapolis School district.

Figure 4.7. NE Perspective

Figure 4.8. NW Perspective

4.3.5. Elevations

Elevations show the buildings materiality as well as its consistancy. With the design aiming to be economical there are only 2 sizes of windows that are used throughout the entirity of the building. The East elevation also show how deleveries access the building through a designated garage entry. This elevation also shows the 2 enteries from the parking lot with emphasis on the right one due to the repeated classroom glazing into the lobby area, allowing for a integrated seating and waiting area.

Figure 4.9. North Elevation

Figure 4.10. East Elevation

4.3.6. Orthographic

The orthographic view shows how the building is orientated towards the lake, creating direct views of the lake and Minneapolis skyline. This view also shows the importance of the courtyards and how they allow every classroom to see outside and some greenery.

Figure 4.11. Orthographic View

4.3.7. Sections

The structure is a combination of concrete, steel, glulam, and wood joists/trusses, shown by the section. The Glulam frames the hallways where direct sunlight penetrates through the courtyards. The courtyards are spaced to allow for maximum sunlight into the next wing of the school. This allows the direct sunlight to clear the peak of the roof during the winter solstice, giving the space abundant year-round daylighting. This daylight is important since it also goes through a shading device and fogged glass to light the back of the classrooms, deeper in the building.

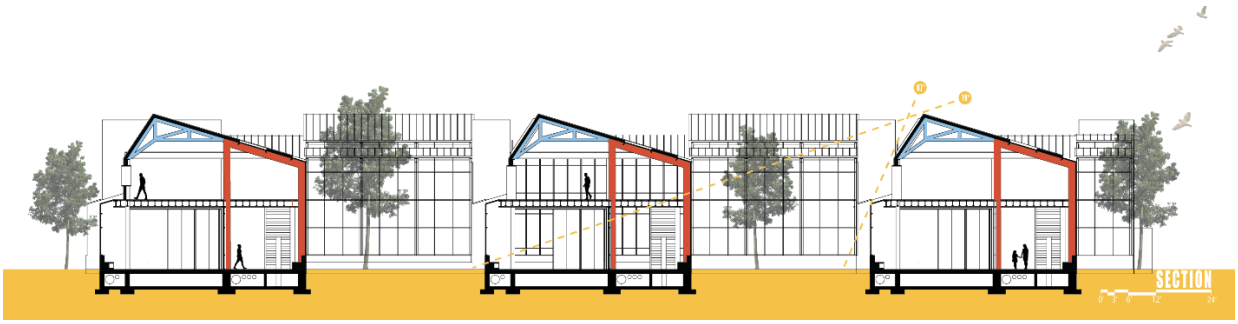

Figure 4.12. Section

Figure 4.13. Section Enlarged

4.3.8. Structure

The structure is designed in a way that no trade has to come back after another finishes to make construction efficient. The goal was to create a structure that is equally simple and elegant and to limit the variety of structural members. With each of the wings being identical structurally, the construction could be streamlined. The structure was designed so that the concrete slab could be poured first, as well as all the concrete walls that are all identical. With identical concrete walls forms could be moved and reused through the process. Then the steel columns and beams could go in. The steel is also mostly all the same size columns and beams throughout with exception to a few moments in the administration area where shorter beams were integrated in a few transitional moments. In the classroom wings all the steel is 24’ distance from column to column and the glulam is 12’ distance. The entire building is on a 3’ grid, with most of the building conforming to a larger 12’ grid as well. The glulam has 2 different members repeated throughout the school depending on whether they butt up against a steel column or if they are standing alone. There are 3 unique glulam beams that are identical to transition the corners from the hallways into the lobby/admin area. Last, to complete the structure the trusses and joists would have to be installed. Every single truss in the project is identical and the joists are identical in all the classrooms, and most of the other spaces.

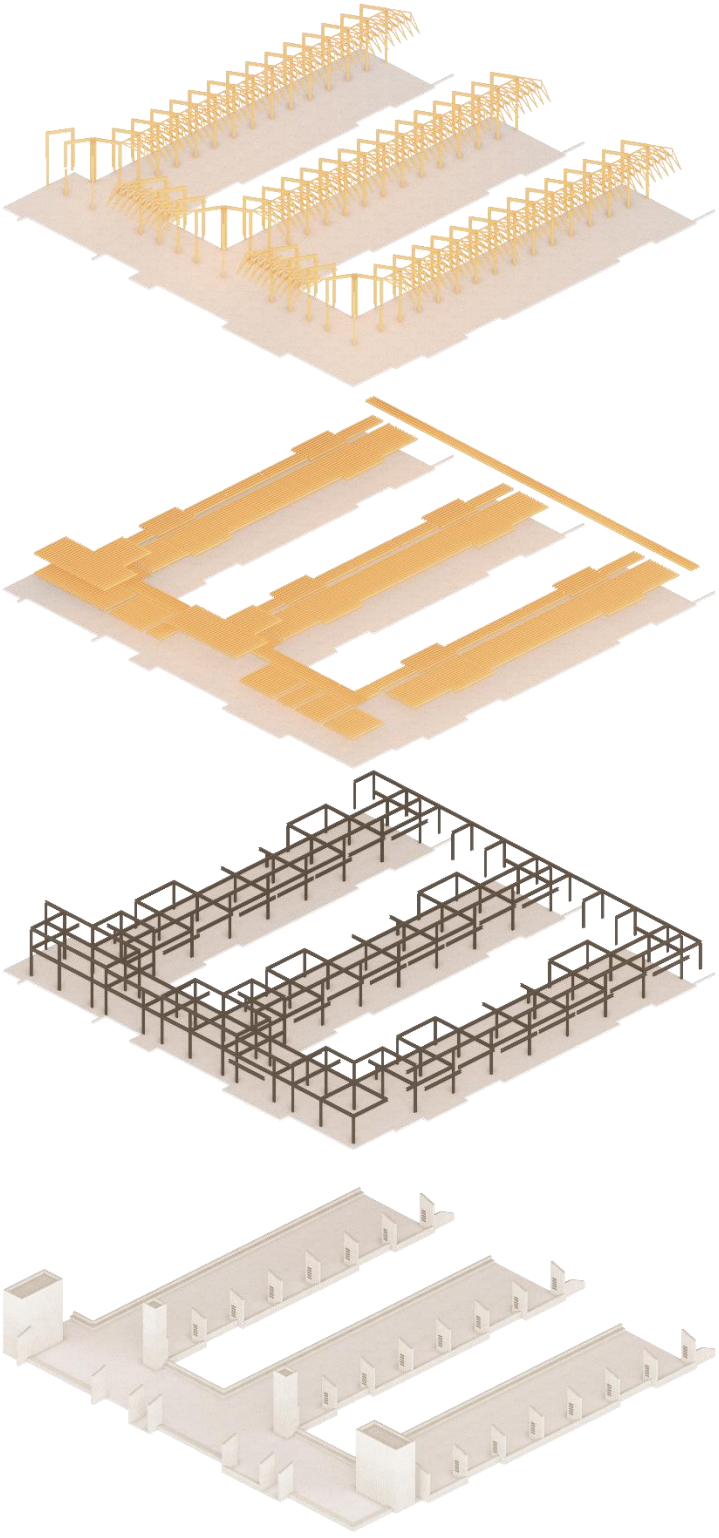

Figure 4.14. Structure Diagram

4.3.9. Interior

The interiors focus is on creating classrooms and environments with ample daylighting for learning. This is created by glazing that appears to extend past the ceiling plane on the north side of classrooms. North facing windows bring in diffused sunlight that is great for reading and consistent lighting, as well as giving every classroom a view of either the lake or the courtyard. The first floor has a 15’ floor to floor height, with a 12’ floor to drop down ceiling height. This allows mechanical to fit between the structure and the ceiling if needed, although most of the mechanical is intended to run in a lower-level crawl space. Besides functional reasons, form wise it also creates an airier and brighter environment, expanding to the outdoors. Classrooms are designed to be adaptable and conducive to learning for all students. Intended to be occupied by 20 students, if necessary, classrooms can adapt to account for an additional 10-15 students. They also lack solid side walls and have partitions to allow class to class interaction and larger spaces if desired.

The classroom’s south facing wall, that faces the hallway has a fogged glass curtain wall followed by a perforated shading screen. This creates the effect of being under a tree as the shading device allows direct sunlight to hit the fogged glass and be diffused, casting diffused light into the classroom. If this wall was solid the classroom would feel overly dark in the back and cave like.

The shading device is better seen in the hallways as it is a wood panel that is repeated and creates an aesthetically intriguing wall besides being functional. Its perforations decrease at eye level to increase privacy and limit distraction within the classroom, from people in the hallway.

Figure 4.15. Classroom Lake Perspective

Figure 4.16. Classroom Daylight Perspective

Characterized by the large glulam structure and expansive glass walls, the hallways provide circulation, interior daylight, as well as support spaces to the classrooms. Seating and lockers provide transition before entering the classroom. The double story space of the hallways are interrupted by a cantilever walkway for second floor circulation. The second floor provides many additional support spaces such as labs, cafeteria, outdoor classrooms, restrooms, and admin.

Figure 4.17. Hallway Perspective

Figure 4.18. Locker Perspective

Being designed for K-5 students, wayfinding different from written signage is critical as reading can be challenging at this age. Each of the three wings have an assigned color of red, blue, or yellow. Key points throughout the school such as doorways and stairs are colored accordingly to guide students. The colors selected are based off a simplification of the Minneapolis school's logo which is also integrated into exterior signage.

Figure 4.19. Stair Perspective

Figure 4.20. Hallway Shading

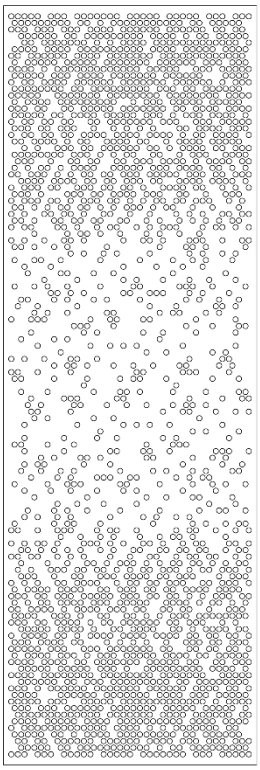

Figure 4.21. Shading Elevation

4.3.10. Model

A physical model was created to further understand the structural relation of the different structural components as well as to analyze daylighting into space. This model, while only just a single classroom, helped show the economical and constructable aspects of the proposal as the repeated components allowed for easy assembly on a small scale.

Figure 4.22. Physical Model

Figure 4.23. Physical Model Aerial

Figure 4.24. Physical Model Side

4.4. Conclusion

In conclusion, this proposal exhibits the beneficial design strategies that affect learning that were found through research and show how architecture can leverage outdoor spaces and natural light to enhance learning. This school design aims to challenge the pure economist view of school design and bring back schools that are focused on the student. With research showing the benefits of daylighting, this proposal displays how a school can combine economics while not sacrificing daylighting and conducive learning environments. It is important to continue to advocate for alternative solutions to the current education system, to better represent those students who are negatively impacted by the common classroom design of the late 1900's, especially those with learning disabilities. While this proposal shows how existing research can be implemented into a design, if provided the opportunity continued research could explore how building materials affect learning, if at all.

Children's education today affects everyone's future, and the current state of American educational architecture is stagnant from a half century of misled and negative ideas. The architecture, education, and design related professions must start a deeper conversation about the negative effects of these ideas and how design can affect change in the system/ outlook of education in the United States. This proposal starts that conversation and shows what the future of education could be. A New School, an alternative learning environment for the future.

REFERENCES

5 Emblematic Buildings by Giuseppe Terragni. (2016, September 6). ArchDaily. https://www.archdaily.com/794411/5-emblematic-buildings-by-giuseppe-terragni

Akinbami, L. J. (2011). *Attention Deficit Hyperactivity Disorder Among Children Aged 5–17 Years in the United States, 1998–2009. 70.*

Amelia County Elementary. (2023, October 10). Virginia School Quality Profiles. http://schoolquality.virginia.gov/schools/amelia-county-elementary

American Institute of Architects Committee on Architecture for Education. (1996). *Educational facilities: 1995-96 review.* Rockport Pub.

Architecture, H. (2017, October 18). Montessori School. *Hidden Architecture*. https://hiddenarchitecture.net/montessori-schoo/

Beltzig, G. (2001). *Kindergarten architecture*. Loft.

CDC. (2021, January 26). *What is ADHD?* Centers for Disease Control and Prevention. https://www.cdc.gov/ncbddd/adhd/facts.html

Costanzo, V., Evola, G., & Marletta, L. (2017). A Review of Daylighting Strategies in Schools: State of the Art and Expected Future Trends. *Buildings*, *7*(2), Article 2. https://doi.org/10.3390/buildings7020041

Curtis, E. (2003). *School builders*. Wiley-Academy.

Educational spaces: A pictorial review of significant spaces. (1998). Images Pub. Group.

Finn, C. E. Jr. (2019). The American K-12 Decline. *National Review*, *71*(21), 44–46.

Ford, A. (2007). *Designing the sustainable school*. Images Pub.

Heschong, L., Wright, R. L., & Okura, S. (2002). Daylighting Impacts on Human Performance in School. *Journal of the Illuminating Engineering Society*, *31*(2), 101–114. https://doi.org/10.1080/00994480.2002.10748396

Irwin, V., Zhang, J., Wang, X., Hein, S., Wang, K., Roberts, A., York, C., Barmer, A., Mann, F. B., Dilig, R., Parker, S., Nachazel, T., Barnett, M., & Purcell, S. (n.d.). *Report on the Condition of Education 2021*.

Jucker, R., & von Au, J. (Eds.). (2022). *High-Quality Outdoor Learning: Evidence-based Education Outside the Classroom for Children, Teachers and Society*. Springer Nature. https://directory.doabooks.org/handle/20.500.12854/91281

LIFE Campus / Vilhelm Lauritzen Architects. (2023, August 22). ArchDaily. https://www.archdaily.com/1005669/life-campus-vilhelm-lauritzen-architects

Logan Center for the Arts, University of Chicago / Tod Williams Billie Tsien Architects. (2012, November 22). ArchDaily. https://www.archdaily.com/296212/logan-center-for-the-arts-university-of-chicago-tod-williams-billie-tsien-associates

Lovell International School / Plan Architect | ArchDaily. (n.d.). Retrieved November 20, 2023, from https://www.archdaily.com/1007248/lovell-international-school-plan-architect?ad_source=search&ad_medium=projects_tab

Mann, J., Gray, T., Truong, S., Sahlberg, P., Bentsen, P., Passy, R., Ho, S., Ward, K., & Cowper, R. (2021). A Systematic Review Protocol to Identify the Key Benefits and Efficacy of Nature-Based Learning in Outdoor Educational Settings. *International Journal of Environmental Research and Public Health*, *18*(3), Article 3. https://doi.org/10.3390/ijerph18031199

Marchant, E., Todd, C., Cooksey, R., Dredge, S., Jones, H., Reynolds, D., Stratton, G., Dwyer, R., Lyons, R., & Brophy, S. (2019). Curriculum-based outdoor learning for children aged 9-11: A qualitative analysis of pupils' and teachers' views. *PLOS ONE*, *14*(5), e0212242. https://doi.org/10.1371/journal.pone.0212242

Mikrut, A., & Szmygin, B. (Eds.). (2015). *Management of UNESCO World Heritage properties in Poland: Selected issues*. Polish National Committee of the International Council on Monuments and Sites ICOMOS ; University of Technology.

National Center for Health Statistics, & Akinbami, L. J. (2011). *Attention deficit hyperactivity disorder among children aged 5-17 years in the United States, 1998-2009*. U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

Roth, A. (1958). *The new school: Das neue Schulhaus. La nouvelle école*. Praeger.

*Sant'Elia Nursery School (1937) **. (n.d.). Retrieved December 4, 2023, from https://insideinside.org/project/santelia-nursery-school/

The Munkegaard School / Dorte Mandrup Arkitekter. (2019, June 21). ArchDaily. https://www.archdaily.com/919433/the-munkegaard-school-dorte-mandrup

University of Michigan School Environments Research Project. (1965). *The effect of windowless classrooms on elementary school children; an environmental case study.* Architectural Research Laboratory, Dept. of Architecture, University of Michigan.

US population over time. (n.d.). USAFacts. Retrieved December 5, 2023, from https://usafacts.org/data/topics/people-society/population-and-demographics/population-data/population/

Zgodic, A., McLain, A. C., Eberth, J. M., Federico, A., Bradshaw, J., & Flory, K. (2023). County-level prevalence estimates of ADHD in children in the United States. *Annals of Epidemiology*, *79*, 56–64. https://doi.org/10.1016/j.annepidem.2023.01.006