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Proximate Environment, Prominent Impact

Stephanie Portmann

Abstract

Proximate Environment, Prominent Impact looks closely at the history and development of learning environments, and, more specifically, early childhood classrooms. While there is much debate around teacher versus child centered learning and pedagogies that have developed in the past century, this capstone focuses on the immediate environments of classroom spaces. I use history, architectural case studies, and scientific research to discuss the ways the physical environment of early childhood education classrooms can impact learning, well-being, and behavior.

Executive Summary

Proximate Environment, Prominent Impact examines and adds to the research of classroom design and its impact on learning. I have focused on early childhood classrooms (ages three to six years old) and studied several components of the physical design of classrooms including lighting, color, and acoustics, and concluded that the architectural treatment of classrooms impacts behavior and social learning.

My interests in education, architecture, and psychology sparked the initial research. The lack of architectural writing on the subject prompted this investigation. While there is copious writing on the effects the physical environment has on behavior, little writing focuses strictly on spaces for learning and, more specifically, early childhood. There are many resources for educators on classroom design and environment in the form of textbooks, guidelines, articles, inspiration guides, blogs, and products (toys, learning materials, furniture, etc.). Some of these focus on specific pedagogies (Montessori, Reggio Emilia, Waldorf, Open Classroom) while others have guidelines and interventions that can be applied to any classroom.

A crucial component of this investigation was studying how children use and respond to their environments. I began working at Bernice M. Wright Child Laboratory School (Syracuse, NY) in September 2017, in a classroom with three and four year old students for fifteen hours per week. During this time, I observed the interactions the children had with each other and the teachers, but also paid attention to how they interacted with their environments—and especially how they actively constructed their physical environment.

I also read a sampling of the educators' resources previously mentioned (blogs, textbooks, design guides) and analyzed specific architectural case studies. In addition to these methods of research, I met with LeMoyne Elementary School Principal Jason Armstrong and had several in-person and Skype meetings with Syracuse University School of Education Doctoral Candidate Meredith Devennie.

Proximate Environment, Prominent Impact is a synthesis of educational, psychological, and architectural writings, investigations, and case studies. It promotes an awareness of architecture's role in shaping behavior and its participation in learning and social development.

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Glossary of Terms

Early Childhood Education The education of children from birth through age 8. These programs are also known as preschool and pre-kindergarten (pre-K).

Pedagogy The theory and practice of teaching. It encompasses learning methodologies and consideration of developmental theories, socio-cultural theories, and behaviorist theories.

Constructivism The idea that learners construct knowledge for themselves. Each learner individually (and socially) constructs meaning as he or she learns.

Student-Centered Learning *(also child-centered learning)* The teacher's role is more that of a facilitator than instructor and students are active participants in the learning process. Students may work alone, in pairs, or groups.

Whole Child Approach An education approach defined by policies, practices, and relationships that ensure each child, in each school, in each community, is healthy, safe, engaged, supported, and challenged.

Inclusive Education Children with and without physical/mental disabilities participate and learn together in the same classes.

Microenvironment The immediate, small-scale environment that is distinguished from its surroundings. This environment is scaled to occupation by individual children or small groups of children.

Teacher-Centered Learning Students put all their focus on the teacher, who is the source of knowledge. Students work alone and collaboration is discouraged.

Chapter 1

Introduction

The role the physical environment plays in shaping human behavior has long been recognized in fields such as architecture, sociology, and psychology. Jeremy Bentham's Panopticon was intended to reduce the number of authoritative figures while increasing compliance. The design of an annular building with a central watchtower and separate cells around the periphery made it impossible to know if observation was occurring, therefore leading to self-policing of behavior for fear of being caught disobeying the rules. Architectural determinism, a theory which may have originated with Bentham's Panopticon, claims that the built environment is the chief determinant of social behavior. City planner and architect Oscar Newman explored the ties between the environment and criminal behavior through his analyses of urban housing projects such as Pruitt-Igoe. Newman's Defensible Space Theory was discussed and critiqued by criminologists, urban planners, law enforcement officials, and architects. In his essay "Figures, Doors, and Passages," Robin Evans studied interactions in domestic architecture through plan and material analyses stating that architecture "encompasses every day reality" and "provides a format for social life."

The physical environment undoubtedly plays a role in everyday life and human behavior, as demonstrated by architectural and scientific research and theories. When instrumentalizing

the physical environment, architecture can be used to control and rationalize human behavior rather than providing liberation and freedom of choice.

Architecture can participate in the production of a positive socio-spatial environment for children's learning that encourages individual agency and self-determination through its ability to shape social relationships in space.

In his article "Utopian Spaces of 'Robust Hope': The Architecture and Nature of Progressive Learning Environments," David Halpin claims that "architecture for childhood" is not taken seriously (Halpin 247). Classroom designs are often based on schedule and activities, catering to institutional needs of economy, safety, and organization rather than children's needs for exploration, creativity, and engagement. Early childhood education pedagogies that emerged in the twentieth century (Waldorf, Reggio Emilia, Montessori, and Open Classroom) demonstrated a shift towards focusing on the development of the whole-child rather than following more traditional educational approaches common in the nineteenth century. Schools are places where learning, socialization, and psychological development coincide, so their physical environment is important. Each pedagogical approach mentioned above has a distinct aesthetic and spatial implications; however, many schools designed to follow specific pedagogies do not reflect this.

Educational buildings and spaces have been developed in larger contexts such as urban and building scale, but the micro-environments (the classroom and conditions within classrooms), although crucial, have not been given much attention and importance by educators

and designers. This capstone will focus on the microenvironment and the levels at which lighting, color, and acoustics can impact learning—at both academic and social levels.

Chapter 2

Early Childhood Education Approaches

In the twentieth century, educators and scholars challenged traditional educational approaches and produced new pedagogies. Denouncing the traditional education models and approaches of the nineteenth century, educators looked to architects to embody the new beliefs through innovative designs.

The traditional approaches designated the teacher as the source of knowledge, placed an emphasis on test taking and performance, and discouraged collaboration. In comparison, the pedagogies that reacted against the traditional education models gave freedom of choice to students, provided personalized learning experiences, and encouraged learning from others. The shift from teacher-centered (traditional) learning to student-centered gave rise to the importance of the relationships between philosophical beliefs, teaching methods, and physical environment. Each of the pedagogies and educational approaches that emerged during the twentieth century falls under the Constructivist umbrella. Constructivism**.** which stems from cognitive science, is an educational theory that places importance on cognitive development and understanding rather than stages of maturation (Fosnot 10). It does not refer to a specific pedagogy, although some pedagogies align with the beliefs of this theory including the importance of play and exploration. Learning is viewed as complex and nonlinear as the construction of knowledge is built through

interactions with the world (Ackerman 15). Children combine prior knowledge and current experiences to build, modify, and reinterpret perceptions and understandings. Constructivist classrooms are typically arranged by content areas and a variety of learning materials are exposed.

Montessori schools are child-centered and based on scientific observations of children from birth to adulthood ("Introduction to Montessori Method"). Dr. Maria Montessori believed that children respond positively to carefully prepared environments, which can be observed in any Montessori classroom. The children have freedom of choice in their learning; the classroom teachers allow students to select what they would like to work on for the day. Because of this freedom, the classrooms are divided into specific curriculum areas with materials (designed specifically for Montessori education) arranged on orderly shelves (Zane 13). These organized, uncluttered spaces allow students to stay calm and focused while working on tasks. The classrooms offer different spaces for learning that are suited for group activity and individual work. Instead of desks, children choose between a variety of surfaces to work on (tables or a mat on the floor) ("Montessori Classrooms"). The orderliness and attitude towards the physical environment and personal space promotes a development and awareness of territory—students learn to define their space and not to infringe on the spaces of others (Hertzberger 78).

Reggio Emilia schools have a self-guided curriculum that promotes exploration and discovery. The Reggio Emilia philosophy encourages relationships with other children and material items, gives endless opportunities for expression, and gives children some control over the direction of their learning. The environment is given fundamental importance in the Reggio

approach, being seen as the third teacher, alongside students and teachers. These classrooms incorporate natural light and plants along with items that provoke discussion and interest (e.g. mirrors, colorful materials in transparent containers, aromas). The classrooms typically open to a center piazza and provide access to outdoor space through large windows, courtyards, and exterior doors. Documentation of learning is a distinct part of the classrooms; evidence of the children's work and interests is displayed throughout the classroom through drawings, structures, and photographs (Strong-Wilson and Ellis 42).

Waldorf education places an emphasis on experience, the senses, and engaging children with the material world (Bjørnholt 117). The curriculum is broken into stages depending on age, with the first stage appealing to the "will, intuition, senses, imagination, and skills of imitation" (Bjørnholt 118). The physical environment of Waldorf schools can best be described as inviting and homey—classrooms often include natural light, flowers, items from nature, candles, and paintings. The colors of Waldorf classrooms change depending on the age: younger children prefer warm, soft colors while adolescents prefer cooler colors (Bjørnholt 121). Classrooms and special rooms (for music, arts, and crafts) are separated to support the specific activities that occur in each of them.

Open Classroom is a philosophical approach embodied through an architecture movement that is child-centered and provides an atmosphere that encourages innovation, exploration, experimentation. The students "learn by doing" through working at specific interest centers such as science, mathematics, motor development, language arts, and domestic (Baron). Instead of traditional classrooms, the schools are often large open spaces with workshops

arranged in separate areas that allow children to work individually or in groups. The flexible areas are intended to provide opportunities for individualized instruction and to allow children to learn at their own pace.

Chapter 3

Lighting

The hum of the overhead fluorescent lights stopped. The room became dark and, within seconds, silent. The child who was skipping around the classroom was now frozen. One child paused to look around the room, quickly observing the other children who had stopped playing, and continued slamming one truck into another. Another child, once deeply focused on putting a diaper on her babydoll, had her concentration broken.

In the 1800s, American educationalist and reformer Henry Barnard criticized the designs of schoolhouses where expediency governed, and buildings had poor lighting and ventilation (Weisser 198). Before the emergence of inexpensive artificial lighting, classrooms relied on natural sources of light and their designs were based largely on the relationship between window sizes and room dimensions (Benya 1). In his book *School Architecture*, Barnard developed standards for distinct aspects of classroom and school design (e.g. lighting, materials, ventilation). Speaking on lighting, he wrote, "Arrangements of light shoud admit abundance to every part of the room, and prevent the inconvenience and danger of any excess, glare, or reflection, or of cross-light." (Barnard 41). He developed a set of standards for windows including orientation, sill heights, and coverings; however, reformers and architects contested

these standards over a century later, arguing that window sills should be at a height children can see while seated, which is still common practice today.

In the 1940s and 1950s, lighting standards for learning environments changed as research grew. Much research was devoted to determining appropriate light level standards, increasing from 30 footcandles to 70 footcandles; however, lighting standards have not changed much since these studies (Baker 14). In his article "Needed Research in the School-Plant Field" educator Ray Hamon pointed out that daylight is measured using footcandles, but the measuring system should be more comprehensive to include glare, illumination, and surface finishes (Hamon 9). These issues may have been heightened by the increased availability of artificial lighting as architects could focus less on natural lighting and distribution.

Scientific research shows that lighting can impact mood, behavior, and performance, although research has not shown consistent results; however, architects became promoters of health, implementing scientific findings and beliefs in the design of buildings.

Alvar Aalto's Paimio Sanitorium (1933), which served exclusively as a tuberculosis sanitorium, was designed to be a contributor to the healing process (Mindell). During this time period, sunlight and ventilation were believed to be the best treatment. The building is oriented so patient rooms receive optimal southern exposure. The artificial lighting in patient rooms differed from the overhead lighting in traditional hospitals, instead being placed near the head of the bed where patients would spend lengthy amounts of time reading.

In the 1910s and 1920s, architects established design rules and guidelines for school buildings that were published and shared across America. Many of these guidelines included standardizations for lighting and windows. Ideally light would come from the left side of the desk to avoid shadows, showing prejudice favoring right-handed students (Weisser 202). In the 1970s, windowless classrooms became popular as thermal comfort and air quality became concerns during the energy crisis. Windowless classrooms provided a space free of distraction and eliminated the issues of excessive brightness, glare, and heat caused by too much direct sunlight. Research at the time showed no negative impacts of windowless classrooms on student performance (Weinstein 592). More recently, studies have consistently shown that lighting does impact physiological functions, performance, and health. In an experiment analyzing the effects of color temperature and illuminance, significant positive changes were found in mood and cognitive performance under higher illuminance and warmer color temperatures (Knez 13). Many experiments have studied the effect of lighting types (warm versus cool) on behavior and performance. Cool white lighting is most effective for attentiveness and focus, while warm lighting increases cooperation.

Newer building systems technologies, mainly in office buildings, allow users to adjust lighting to meet individual preferences. Experiments and research on the impact lighting has on behavior, health, and performance show consistent results regarding illumination and color temperatures; however, most classroom designs do not reflect this. The fluorescent lighting of typical classrooms puts emphasis on economy and maintenance rather than the child.

Chapter 4

Color

She took three steps into the classroom and her body was still except for her eyes. They darted around for several seconds, then stopped as she focused on something—a piece of yellow paper larger than her body that was covered in bright paint and glitter.

It is important to study and understand what color is and the ways it can be used in learning environments. Color has three basic properties: hue, saturation, and value. Hue is the name of a color (e.g. green, blue, red), saturation (intensity or chroma) is the purity of a hue (a decrease in purity makes a hue look dull), and value is a hue's lightness or darkness (adding white lightens a hue whereas adding black darkens the hue. Temperature is another way color is described. Cool colors (shorter wavelengths) are blue, green, purple, and some yellows. Warm colors (longer wavelengths) are red, yellow, orange, and some purple.

Color can produce psychological and physiological responses. Changes in mood and attention are psychological effects, and physiological responses may include changes in heart rate, temperature, and brain development (Gaines, Curry 49). Many studies of color have been analyzed at small-scales using color samples and chips; however, environmental psychologist

Rikard Kuller experimented with color at full-scale (room). He studied the effects of specific colors and found that they impacted perception, emotions, and physiology of experiment participants (Kuller 151). A study in a classroom of six-year-old students found that students in a classroom with light blue walls and full-spectrum lights had an average blood pressure 9% less than a classroom with white walls. In the same experiment, off-task behaviors decreased by 22% in the colored classroom (Graangard).

While there are guidelines for the applications of color based on desired emotions and behaviors, differences in gender and age result in different color preferences and emotional responses (Gaines 52). Table 1 (see appendix) shows the physiological and psychological effects of color.

Color can be implemented in specific ways to to accomplish desired outcomes or behaviors, although designers should be wary of using too much color, as that can cause overstimulation; however, an understimulating environment can also produce negative results. When designing learning spaces, designers and educators should focus more on the functional aspects of color rather than aesthetic ones.

Chapter 5

Acoustics

Feeling restless, his body wiggled around as he tossed and turned. First, he tapped his foot on the squishy, foam mat. Next, his lifted his arms up and his hands hands moved quickly over the surface of the wall, which was covered in a large piece of paper the children had painted the day before. After hearing the crinkling of the paper moving under his fingers, he quickly looked up to find out what made the unexpected noise. He continued sliding his hands across the surface, and soon, the child laying next to him did the same.

Early school buildings and one-room schoolhouses followed teacher-centered learning where the teacher was the source of knowledge and collaboration was discouraged. These schools were often intended to teach large numbers of students with very few teachers (Robson 11). It wasn't until the 1940s that architects started devoting time and attention to the acoustical performance of classrooms (Baker 15). Educator Ray Hamon explained that changing approaches for teaching and learning led to a greater need for acoustical control (Hamon 6). In October 1949, *Architectural Forum* published an issue focused on schools and included sectional diagrams of classrooms (see appendix), showing the locations of sound-absorbing materials and explaining how each performed (Luce 152). Four basic requirements for acoustical performance of classrooms were shared: "1) Sufficiently low level of background noise. 2) Adequate

separation of successive sounds. 3) Proper distribution of sound within the space. 4) Sufficient loudness of sounds" (Luce 152). In this issue, acoustics received just as much attention as lighting and ventilation; however, these practices didn't become common until many years later (Baker 16).

In the 1960s and 70s when open plan schools (Open Classroom) became popular, acoustical control became a significant subject of study for designers. Despite major differences in teaching methods and classroom separation, the National Council on Schoolhouse Construction determined that open plan classrooms and typical classrooms had roughly the same amount of noise (107). Architectural psychologist Rotraut Walden, in her book *Schools for the Future: Design Proposals from Architectural Psychology*, defines noise as a sound that "occurs in a loud, unpredictable, and uncontrollable fashion" (Walden 102), whereas acoustics is a term used to talk about how sound travels in a room ("Classroom Acoustics").

In an article published by The Review of Educational Research, two types of studies on noise and student achievement are defined: "a) *short-term* exposure to moderate noise originating *within* the school; and b) studies of *long-term* exposure to more severe noise from an *external* source such as an airport or highway" (Weinstein 590). After analyzing several studies, Weinstein concludes that lower performance is not necessarily linked to noise being present, but rather long-term exposure leads to lower performance (589-591). Walden's writing and conclusions align with the studies Weinstein analyzed; she clarifies that lower performance *is* linked to noise, but that it is a result of misinterpretation or misunderstanding due to poor hearing conditions (103). She continues to write that her conclusions of noise do not call for "absolute

quiet", but instead natural sounds (e.g. birdsongs, rain, from self-guided activities) can be beneficial to the human body (103).

The American National Standards Institute (ANSI), written by the Acoustical Society of America (ASA) designates standards for and methodologies to achieve adequate acoustical performance in classrooms and schools. American Speech-Language-Hearing Association (ASHA) has a lengthy list of classroom modifications that can aid in mitigating noise. These modifications include using sound-absorbing materials for ceilings, walls, and floors, staggering/angling furniture to reduce noise reflection on hard surfaces, and regularly maintaining fluorescent lighting to avoid the hum ("Classroom Acoustics").

ANSI's classroom standards state that classrooms with ceilings 10 feet or lower have adequate reverberation time, and ceiling heights higher than that will require some/significant sound-absorbing material on the ceiling and side walls. Echo in spaces are often caused by large, flat surfaces—especially those opposite the source of the noise—so surfaces should be broken up with furniture, sculpture, acoustic panels, or angled walls ("Acoustical Performance Criteria").

There are many guidelines that designers and educators can apply to learning spaces; however, architects can use spatial/programmatic separation and sound-absorbing materials in classroom designs to abate undesired noise and sounds.

Chapter 6

Conclusion

Through analyses of architectural case studies, research of classroom design, psychological and physiological findings, and from personal observations in an early childhood classroom, this capstone concludes that the treatment of the classroom including it's lighting, colors, and acoustics can impact learning at both social and academic levels.

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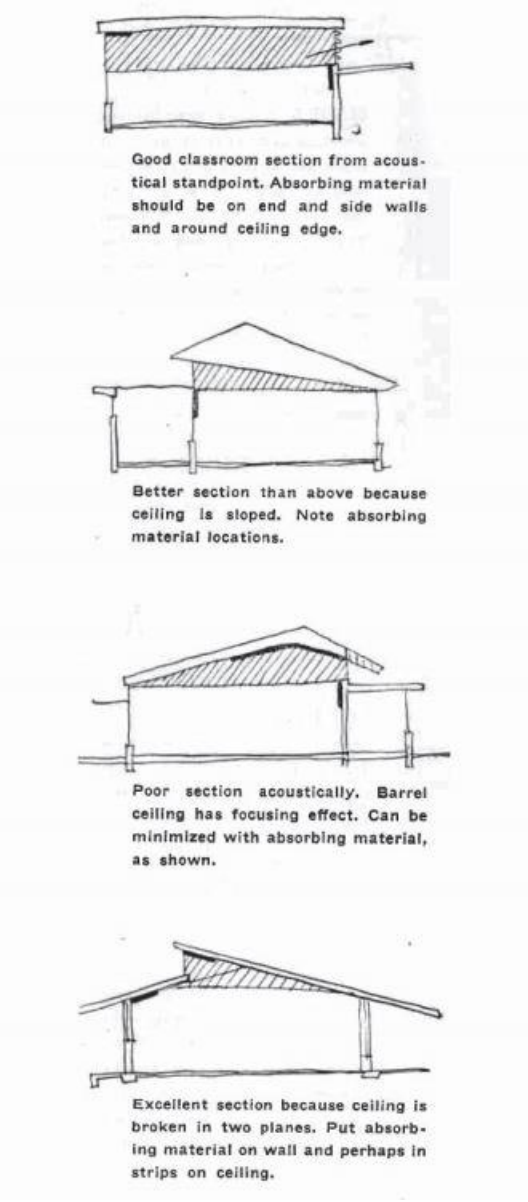
Appendices

Table 1 *Emotions and Physiological Responses Related to Color*

Color	Psychological Responses	Physiological Responses
Red	Exciting Stimulating	Concerned with motor skills Raised blood pressure Increased respiration Heightened sense of smell
Blue	Calming	Lower body temperature Reduced appetite Reduces pain Lower heart rate Increased concentration
Yellow	Increases creativity Increased attention	Increased heartrate (when too much is present)
Green	Peaceful and calm	Affects developing speech skills Most restful for the eye
Orange	Alertness Social	Tonic effect Increases appetite
Violet	Peaceful and calm	
Pink	Soothing	Reduced aggression
Black	Mystery Strength Negativity	

Figure 1 *Classroom Acoustics from Architectural Forum*



Good classroom section from acoustical standpoint. Absorbing material should be on end and side walls and around ceiling edge.

Better section than above because ceiling is sloped. Note absorbing material locations.

Poor section acoustically. Barrel ceiling has focusing effect. Can be minimized with absorbing material, as shown.

Excellent section because ceiling is broken in two planes. Put absorbing material on wall and perhaps in strips on ceiling.