ARCHITECTURE CAPSTONE

SCHOOL DESIGN FOR HEALTH & WELLBEING

2021
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Problem

Lack of Healthy School Design

The environment in which students learn largely impacts their health, well-being, and levels of achievement. Within the United States, healthy school design is lacking, and many of the public schools provide unhealthy environments that are too often in states of disrepair. This places students at a disadvantage, hindering their academic achievement levels and their overall health. The COVID-19 era has brought the health of students in learning environments to the forefront of the educational discussion. Many schools have transitioned to remote learning as they have struggled to accommodate students safely. Seeing that the spread of COVID-19 may continue into the foreseeable future, schools must be designed to safely accommodate students and allow them to progress in their learning. A school design that prioritizes occupant health can allow students to successfully learn through out current COVID-19 pandemic and throughout the future as we begin our new normal.
School Typology Precedent

Open Air School

Time period: 1930-1945

The Open Air School Movement focused on open air, fresh air, or outdoor schools, and prioritized daylighting, outdoor learning, and easy circulation. This was an emerging educational model that enabled children to attend school while prioritizing their health. The Open Air School Movement began largely due to the tuberculosis outbreak which was a leading cause of mortality in the United States (Means 150). Although this movement passed with the coming eras, it promoted the open-air idea and brought us closer to the realization of how school design can promote child health and education (Means 151).
Learning environments have a significant impact on student’s health, achievement and overall experience. It is imperative that learning environments be designed to maximize the impact on student health and learning. Through preforming a meta-analysis of learning environment design and its impact on the user, I have concluded that the following six categories must be carefully incorporated into the design of these spaces.

Children are more susceptible to negative impacts of the indoor environment, therefore, it is imperative that schools are designed to help foster a healthy environment for student learning and development. All six aspects of sustainable design that I have mentioned must be integrated with one another in the design of schools. One aspect cannot succeed without the others, all aspects of sustainable design must be implemented and realized through design. However, it does not stop here, buildings must be properly maintained through the lifespan to preserve the function and health of the space.

1. INDOOR AIR QUALITY & VENTILATION
   Increased ventilation rates in classrooms have a positive effect on short-term concentration and logical thinking of children performing schoolwork.

2. QUALITY VIEWS
   Views to green outdoor spaces keep students connected with the outdoors and time of day. Green views have been shown to improve student attention spans by up to 13%.

3. DAYLIGHTING & LIGHTING
   Daylight and artificial light have a positive effect on human behavior, one study showed a 26% improvement on standardized tests in optimal lighting conditions.

4. THERMAL COMFORT
   Students in thermally comfortable environments were shown to achieve a 4% higher test score than those in uncomfortable thermal environments.

5. MATERIALS
   Volatile organic compounds (VOC) are emitted into the air from building materials. Relationships have been found between VOCs and chronic Sick Building Syndrome.

6. ACOUSTICS & NOISE POLLUTION
   Student performance in reading and language subject areas decreases with an increase in background noise.

* See appendix for meta-analysis details
Design Proposal & Brief

Architectural Intent

School learning environments can greatly affect student health and achievement. Many schools in the United States are overcrowded and in states of disrepair, placing the students at a disadvantage. I am proposing the design of a public high school building to promote student achievement, while focusing on overall occupant health. This school promotes health and wellbeing through spatial layout and design of the indoor learning environment.

The school can safely accommodate students during the COVID-19 pandemic, and through the future. The small scale design, accommodating 200 students will limit large scale gatherings and limit student contact to those within their classroom unit. This school will act as a model to follow for future school design that promotes students health, wellbeing, and achievement.
Site Design
Pittsburgh, PA

Hazelwood Green is an undeveloped brownfield along the Monongahela River in the Greater Hazelwood neighborhood in Pittsburgh. The site was a polluted industrial area in the past, but has undergone years of soil remediation, and is prepared to incorporate 8 million square feet of development. This site is a prime area for the development of a public high school due to its connection with existing public transportation, pedestrian and bike routes within Pittsburgh. The site is also in close proximity to buildings which are used by Carnegie Mellon University, offering further educational opportunities for students.
CLASSROOM UNIT DESIGN

Each classroom unit contains a lecture-based room and a lab/interactive room. The classrooms were arranged on site to take advantage of natural ventilation, views, and natural lighting. The classrooms open to the exterior, creating a seamless connection between indoors and outdoors. Students will remain within one classroom unit throughout the day, rotating between the two rooms, limiting contact with others. Multiple classroom units were combined together to create the classroom wings of the building.

Students will report to one classroom unit each day. During class period changes, students will rotate between lecture (red) and lab (yellow) rooms, while staying within a single classroom unit. This limits the contact between students to those in their classroom unit rather than students within the entire school. Students from grade levels 9-12 will learn together within the units.

CLASS SCHEDULE ROTATION

Health & Wellness

- **Thermal Comfort**: Operable windows accessible to students and faculty for operation.
- **Air**: 100% of occupied spaces have mixed mode ventilation with operable windows leveraging prevailing breezes.
- **Daylighting**: Classrooms receive sufficient daylighting while limiting glare.
- **Acoustics**: Cork wall panels within classrooms provide acoustical environments suitable for teaching and learning.
- **Materials**: Interior finishes limit VOCs and chemicals that are harmful to occupants.
- **Views**: 90% of occupied spaces have direct views to the outdoors.
KEY:
1. ADMINISTRATION
2. CUSTODIAL
3. CAFETERIA
4. GYM
5. MECHANICAL
6. NURSE
7. HEALTH SCAN
8. CLASSROOM - LECTURE
9. CLASSROOM - LAB/INTERACTIVE
10. OUTDOOR LEARNING / GARDEN
11. QUAD
12. BUS DROP OFF
13. ARBORETUM
14. PARKING
15. MILL-19 (EXISTING BUILDING)
16. SPORT FIELD

FIRST FLOOR PLAN
SECTION 2

SCALE

FEET

30  0  30  60
CLASSROOM VIEW

Material Guidelines:  
- Red List Free  
- Non-toxic products  
- No PVC or Vinyl  
- Declare Label

1 Low VOC Paint - Limits the amount of volatile organic compounds that are off-gassed.
2 Cork Wall Panels - Natural material, improves acoustical quality of the classroom.
3 Bio-Floor tile - PVC free, low VOC. Easy to clean and keep sanitary, unlike carpeting.
4 Low VOC Furniture - Contains no toxic chemicals and limits VOC off-gassing.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Research Method</th>
<th>Participants</th>
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<tbody>
<tr>
<td>1. Mendell et al.</td>
<td>Quantitative</td>
<td>2-5, 18 (elementary)</td>
<td>616 students</td>
<td>5 y</td>
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<td>Classroom carbon dioxide concentrations</td>
<td>Test performance</td>
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<td>2. Pakeman et al.</td>
<td>Quantitative</td>
<td>3 &amp; 4 classroom</td>
<td>48</td>
<td>-</td>
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<td>Classroom carbon dioxide concentrations</td>
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<td>3. Shakoori et al.</td>
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<td>5. He et al.</td>
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<td>6. Brännström et al.</td>
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<td>2; 6; 8 classrooms</td>
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<td>33 fifth grade &amp;</td>
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Table 3. Sources Included in Meta-Analysis: Acoustics Category

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Table 1. Sources Included in Meta-Analysis: Ventilation Rates Category
Table 4. Sources Included in Meta-Analysis: Quality Views Category

Table 5. Sources Included in Meta-Analysis: Materials Category
BIBLIOGRAPHY


Santos, Julianna, et al. “Exposure to Sound Pressure Levels in the Classroom, Acoustic Immittance and SSW Test in Students of 3 and 4 Degree of Elementary School.”


