



School Buildings

A Report on How Facilities Contribute to the Mission of the School

Student achievement

Improving student learning is of vital interest to educators, administrators, legislators and parents across the country. Their mission is to create great schools with high academic standards for all students.

While every student should be learning and succeeding in school, the reality is that many students are struggling, and the reasons they are struggling are as diverse and complex as the students themselves.

The National Education Association has identified a number of key issues related to student success, including achievement gaps, testing, students with special needs, and curriculum. However, another important factor are the building themselves.

The average public school building is 42 years old and according to a 1999 study by the U.S. Department of Education, about 40 percent of schools report unsatisfactory environmental conditions¹. What affect does the quality of school buildings have on student achievement? How do facilities impact the success of a school?

Indoor environment

Research suggests that a classroom's indoor environment, including lighting, temperature, humidity and noise level, plays a significant role in a student's ability to concentrate and learn.

¹ Condition of America's Public Facilities: 1999, U.S. Department of Education, National Center for Education Statistics.

According to the U.S. Environmental Protection Agency, more than 53 million children and about 6 million adults, or one in five Americans, spend a portion of their day inside school buildings. Furthermore, a significant number of students and teachers struggle with such distractions including noise, glare, mildew, lack of fresh air, and hot or cold temperatures.²

Despite the fact that the student population has grown from 25 million in 1950 to more than 47 million today (and is expected to increase by 2 million students by 2013), more than 73 percent of schools were built before 1970.

A number of recent studies evaluated the relationship between school buildings and student achievement and found higher test scores for students learning in better buildings and lower scores for students learning in substandard buildings.

A survey of New York State school nurses found that 71% reported knowing students whose health, learning, or behavior was affected by adverse building conditions.³

For example, one recent study showed a difference in student test scores ranging from 5 to 17 percentage points. According to the Council of Educational Facility Planners International, facility condition may have a greater impact on student performance than the combined influences of family background, socio-economic status, school attendance, and behavior.

² Do Indoor Environments in Schools Influence Student Performance? 2003 Lawrence Berkeley National Laboratory

³ National Trends and Prospects for High-Performance Green Buildings. Healthy Schools Network, 2000

Another study, conducted in 1999 by the Heschong Mahone Group, found a statistical correlation between the amount of daylight in elementary school classrooms and the performance of students on standardized math and reading tests. The study analyzed test score records for more than 21,000 students in three school districts in San Juan Capistrano, California; Seattle, Washington; and Fort Collins, Colorado. Results of the study indicated that elementary school students in classrooms with the most daylight showed a 21% improvement in learning rates compared to students in classrooms with the least daylight.

Children have greater susceptibility to some environmental pollutants than adults, because they breathe higher volumes of air relative to their body weights and their tissue and organs are actively growing (Faustman et al. 2000; Landrigan 1998) Children also spend more time in schools than in any indoor environment other than the home. Adverse environmental effects on the learning and performance of students in schools could have both immediate and lifelong consequence, for the students and for society

One adverse effect of poor indoor environmental conditions in schools is asthma. Asthma is a chronic disease that accounts for a half million hospitalizations and 5,000 deaths each year. The number of asthmatic children increased 60 percent in the 1980s and totals more than 4.8 million today. In a classroom of 30 children, about three are likely to have asthma. In fact, the American Lung Association (ALA) found that American children miss more than ten million school days each year because of asthma exacerbated by poor IAQ.⁴

The National Clearinghouse for Educational Facilities study, conducted in 2003, documents how a large sample of teachers in Chicago and Washington, D.C. rate the working conditions in their schools and how they perceive these conditions affecting their job performance and teaching effectiveness.

4 Do Indoor Environments in Schools Influence Student Performance? 2003 Lawrence Berkeley National Laboratory

The teachers surveyed in both cities reported facing daily problems with their buildings. On a graded A-through-F scale, the teachers scored their facilities just above a C, or 2.17. Washington schools scored 1.98; Chicago schools scored 2.50.

About one-third of Chicago teachers and more than one half of Washington teachers were dissatisfied with their facilities. When asked if they thought their facilities were suitable for effective teaching and learning, a significant number—about 20 percent of Chicago teachers and 40 percent of Washington teachers—said no.

In 1995, the U.S. Government Accounting Office released a survey indicating that more than half of U.S. schools have insufficiencies that negatively affect indoor air quality.⁵ In addition to triggering asthma attacks in children, poor indoor air quality reduces attentiveness causing learning to be compromised.

Combined, these research findings suggest important implications for the design of school buildings.

Noise / Acoustics

Much of the education that takes place in K-12 classrooms hinges on oral communication. Each student plays an active role in that process by analyzing and evaluating what s/he hears based on individual experience and understanding of language.

Good acoustics are fundamental to good academic performance.

Numerous factors determine the sound levels in a particular room, including: where the building is situated; the size and shape of the room; its placement relative to other interior spaces; surface treatment (which determines sound absorption) and construction of the ceiling, walls, and floor; the number, type, and location of sound sources, and the strength of the sounds they produce.

5 School Facilities: Condition of America's Schools, 1995, U.S. Government Accounting Office.

Experts believe that as many as one-third of all students miss up to 33 percent of the oral communication that occurs in the classroom⁶

Speaker-to-listener distance (SLD) plays a role as well. As the distance between speaker and listener increases, the loudness of the signal, and therefore the signal-to-noise ratio, decreases. When audibility of words is reduced by 50% (still easy for adults) children cannot understand most of what is said. In conditions where adults can just barely understand most of the words spoken (25% audibility) young children 5 to 7 years of age can understand almost nothing, even when words are familiar.⁷ Associations between reading ability and noise exposure in elementary school children have been shown in multiple studies.⁸

But noise in the classroom does not only affect the children. One study showed a 36 percent drop in teacher absenteeism in sound enhanced classrooms⁹

Research has shown a direct correlation between the implementation of classroom sound enhancement systems and improved academic performance (10-15 percent gains per year) regardless of class size, individual learning needs, socioeconomic status, and English Language proficiency.¹⁰

High performance schools

It is clear that the condition of school facilities can be directly linked to the quality of education and to teacher morale and teacher productivity. Research has uncovered growing evidence showing that conditions like these and many other aspects of school facilities have a considerable and often negative impact on education.

6 M. Nixon. 2002. "[Acoustical Standards Begin to Reverberate: Controlling Noise within School Facilities.](#)" School Construction News Online.

7 Sound in the Classroom, Why Children Need Quite, 2003 ASHRAE Magazine

8 Characterization of Guidance Documents for Creating High Performance Schools

9 High Performance Schools=High Performing Students, Educational Facility Planner, Volume 39, Issue 3 23

10 High Performance Schools=High Performing Students, Educational Facility Planner, Volume 39, Issue 3 23

High performance schools are facilities that improve the learning environment while saving energy, resources and money. According to the Sustainable Buildings Industry Council (SBIC), school districts can save 30 to 40 percent on utility costs each year for new schools and 20 to 30 percent on renovated schools by applying sustainable, high performance design and construction concepts.

A correlation study conducted in the Washington D.C. school system revealed that educational building conditions may be affecting student performance and estimated that improved facilities could lead anywhere from a 5.5% to 11% improvement on standardized tests¹¹

As school administrators deal with overcrowding and inadequate facilities, creating a comfortable, high performance environment for students can help contribute to the academic success of students, as well as to the financial and environmental performance of schools. High performance schools can provide remarkable benefits, including increased attendance, healthier indoor air quality, reduced operating costs, reduced liability, and reduced environmental impact.

Creating a high performance school requires an integrated approach to the design process, in order to produce efficiencies that can lead to cost savings. Building systems, such as controls, lighting, HVAC, electrical, plumbing, flooring and ceiling, must be considered together at the beginning of the design process.

Conclusion

Many U.S. schools are overcrowded and in a state of disrepair, often with substandard plumbing, and inadequate HVAC systems. In the American Society of Civil Engineers' latest assessment of the nation's infrastructure, U.S. schools earned a D grade¹². This is hardly the ideal environment in which children, our most precious commodity, should learn.

The U.S. General Accounting Office estimates that it will cost \$112 billion to bring existing K-12 public schools to proper standards. Another \$73 billion is needed to add new facilities when the student population increases from 53 million to 54.4 million as expected by 2008. Now is the time to consider the impact of school facilities on learning and fulfill schools' missions to establish successful schools by properly investing in the future of education.

Creating a comfortable, high performance environment for U.S. students can help improve their academic performance. A well-designed school can enhance student and teacher performance and make education a more enjoyable and rewarding experience. A healthy learning environment is integral to providing quality education.

¹¹ The Overlooked Half of a Large Whole: The Role of Environmental Quality Management in Supporting the Educational Environment, Jeffery A. Lackney, R.A., Ph.D

¹² 2005 Report Card for America's Infrastructure, American Society of Civil Engineers.



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