



# INFORMATION CAPSULE

## Research Services

Vol. 1204  
August 2012

Christie Blazer, Supervisor

## THE IMPACT OF SCHOOL BUILDINGS ON LEARNING

### **At a Glance**

*This Information Capsule examines the impact of deteriorating school buildings on students and teachers. Research indicates that students attending schools that are in poor physical condition score lower on achievement tests than students in newer, functional buildings. Studies suggest that several specific factors contribute to lower levels of student performance, including poor air quality, excessive temperatures, poor lighting, and high levels of noise. Deteriorating schools have also been found to have a negative impact on student and teacher morale and have been linked to higher levels of teacher turnover.*

Many educators maintain that the debate over how to improve education in the U.S. has ignored one critical element: the physical condition of schools. Students and teachers are held accountable for their performance, but it is extremely difficult to raise levels of academic achievement when teaching and learning take place in crumbling, antiquated facilities (Yeoman, 2012; American Federation of Teachers, 2006).

Millions of students attend structurally deteriorating schools that put their health and safety at risk on a daily basis. According to the Government Accountability Office and the American Society of Civil Engineers (as cited in Filardo et al., 2011), school districts have been under-spending on maintenance and repair for many years.

Substandard school buildings frequently have unsafe drinking water, moldy environments, inadequate fire alarms and fire safety, inadequate ventilation, insufficient lighting, noisy classrooms, no wiring for technology, peeling paint, and crumbling plaster (Yeoman, 2012; Filardo et al., 2011; Earthman, 2004; U.S. Department of Education, 2000). The American Federation of Teachers (2006) surveyed nearly 1,000 teachers and school staff across the U.S. and reported school building problems that included “rodent infestation, mice droppings, fallen ceiling tiles, poor lighting, mold that has caused mushrooms to grow, crumbling exterior walls, asbestos, severely overcrowded classrooms and hallways, freezing rooms in the winter and extreme heat in the summer, old carpeting, clogged bathroom toilets and no stall doors, inadequate circuit breakers causing frequent outages, and poor ventilation.”

Studies have concluded that low-income and minority children are more likely to attend schools that are in poor physical condition (American Federation of Teachers, 2006; Earthman, 2004; Schneider, 2002). The 21<sup>st</sup> Century School Fund reported that from 1995 to 2004, the country's most disadvantaged students received about half of the funding for their school buildings (\$4,800 per student) as their more affluent peers (\$9,361 per student). In addition, districts with predominantly white students had significantly higher spending on their school facilities than districts with predominantly minority students. Spending on school construction from 1995 to 2004 ranged from an average of \$5,172 per student in districts with the highest concentration of minority students to \$7,102 per student in districts with the highest concentration of white students (Filardo et al., 2006).

The age of a school building is a strong predictor of building condition. Older buildings are less likely to have features such as controlled temperatures, acceptable lighting, good acoustics, and wiring for technology that are necessary for a quality learning environment (Earthman, 2004). Schneider (2002) pointed out, however, that the age of the school building itself should not be used as a measure of its quality. He noted that some schools built in the 1920s and 1930s still provide, with some modernization, excellent learning environments, while many schools built in the cost-conscious 1960s and 1970s do not.

## STUDENT ACHIEVEMENT

Numerous studies have concluded that students in substandard school buildings perform at lower levels than students in newer, functional buildings. Researchers have found that students in deteriorating school buildings score between 5 to 11 percentile points lower on standardized achievement tests than students in modern buildings, after controlling for income level. In addition, some experts believe that the negative impact of substandard school buildings may be cumulative and continue to increase the longer the student attends an older, deteriorating school (Filardo et al., 2011; Hatfield, 2011; Cash & Twiford, 2010; Wilson, 2008; Earthman, 2004; U.S. Department of Education, 2000).

While the cumulative effect of the school building's condition has been linked to lower levels of student performance, further research has identified several specific factors that contribute to these outcomes, including:

**Air Quality.** Evidence indicates that poor air quality contributes to students' asthma, absences due to illness, difficulty concentrating, and lower achievement (Baker & Bernstein, 2012; American Federation of Teachers, 2006; Earthman, 2004; Schneider, 2002).

- The American Lung Association (as cited in Hatfield, 2011) reported that in 2008, 14.4 million school days were lost in the U.S. due to absences caused by asthma. Asthma is often attributed to persistent exposure to the airborne pollutants and poor ventilation found in deteriorating schools.
- The incidence of doctors' diagnosed asthma symptoms was found to be significantly higher in students attending schools with high counts of settled dust on the floor and furniture than for students in cleaner buildings (Smedje & Norback, 1999, as cited in Earthman, 2004).
- Concentration of carbon-based chemicals caused by malfunctioning ventilation systems has been linked to lower levels of student performance on tasks such as visual signal and color discrimination response reaction times (Earthman, 2004).

- Studies show that good ventilation is particularly important for children, especially those under 10 years old, because they inhale a greater volume of air in proportion to their body weights than adults do. Dust, mold, bacteria, allergens can cause major harm to young respiratory systems (Hatfield, 2011; Schneider, 2002; U.S. Department of Education, 2000).

**Temperature Range.** There is extensive research demonstrating a strong relationship between a comfortable temperature range and student achievement. Poorly functioning cooling and heating systems struggle to maintain temperature and humidity levels, subjecting students to classrooms that are too cold, too hot, too damp, or too dry (Hatfield, 2011; Earthman, 2004).

- Studies have found that students perform mental tasks best in rooms kept at moderate humidity levels (40% to 70%) and temperatures in the range of 68 to 74 degrees Fahrenheit. As students report greater discomfort, their achievement and task performance deteriorate (Earthman, 2004; Schneider, 2002).
- Students in non-air conditioned buildings have been found to perform 3 to 12 percentile points lower on measures of student achievement than students in air conditioned buildings (Earthman, 2004).
- Studies have found that reducing the classroom temperature in warm months (from 77 to 68 degrees Fahrenheit) increases the rate at which students perform basic tasks, such as subtracting numbers, categorizing logical statements as true or false, and comprehending text. A reduction of air temperature by 1.8 degrees Fahrenheit (within the range indicated above) was shown to improve performance in terms of speed by 2% to 4% on performance tasks (International Centre for Indoor Environment and Energy, 2009; Wyon & Wargocki, 2007, as cited in Baker & Bernstein, 2012).

**Lighting.** A number of studies have demonstrated that appropriate lighting is positively related to increases in student achievement. Conversely, in schools where the lighting is of poor quality, students do not perform as well as students in properly illuminated school buildings (Earthman, 2004; Schneider, 2002).

- During the 1970s and 1980s, many schools were built with no windows to save energy. Use of fluorescent lamps was common. However, most experts now agree that controlled daylight, combined with appropriate artificial lighting when needed, provides students with the best lighting conditions (Baker & Bernstein, 2012; Cash & Twiford, 2010; American Federation of Teachers, 2006; Schneider, 2002).
- Studies conducted to determine how much of the increase in student performance can be attributed directly to lighting conditions have produced varying estimates, ranging from 0.3% to 26% (Baker & Bernstein, 2012). Hatfield (2011) reported on a series of studies that analyzed standardized reading and mathematics scores among students exposed to different lighting conditions. Students exposed to the most daylight were found to have a 21% increase in performance compared to students exposed to the least daylight. The original study controlled for student demographics and years of teacher experience and was replicated in three different school districts, then verified by a re-analysis of the data two years later.

**Acoustics.** Research shows that there is a correlation between appropriate acoustical conditions and student achievement. Studies have found that high levels of noise, both inside

and outside of the classroom, have a negative impact on student performance (Baker & Bernstein, 2012; Earthman, 2004).

In substandard school buildings, old air conditioning, electrical, and plumbing systems contribute to ambient noise. New and renovated schools are equipped with quieter HVAC systems and often include absorptive acoustical treatments for classroom walls, floors, and ceilings that reduce disruptions from adjacent classrooms or nearby facilities, such as highways, airports, or construction sites (Hatfield, 2011).

- Studies have found that children in loud classrooms score significantly lower on standardized tests measuring reading and mathematics abilities than children in quieter classrooms (Hatfield, 2011; Schneider, 2002).
- According to Earthman (2004), a California study found that third grade students in noisy buildings were .4 years behind in reading and .2 years behind in math than students in quieter classrooms. Sixth grade students in noisy buildings were .7 years behind in reading.
- The American Federation of Teachers (2006) reported that speech recognition by regular education students under noisy conditions can drop from an average of 95% to as low as 30%.

## **STUDENT ATTITUDES**

Experts agree that deteriorating schools affect student morale. Studies indicate that student attitudes become more positive after they move into new or renovated school buildings (Filardo et al., 2011; Cash & Twiford, 2010; Wilson, 2008; Earthman, 2004; U.S. Department of Education, 2000). The American Federation of Teachers (2006) noted: “The failure to invest in school buildings sends a cynical message of indifference to students, rather than showing them that we value their education.”

Although it is not possible to establish a causal link between improved school attitudes and new or renovated school buildings, findings suggest a strong association between new surroundings and improvements in students’ perceptions of their educational experience. Pre- and post-move surveys administered to high school students by Rudd and colleagues (2008) found that the greatest improvements in attitudes were in students’ feelings of safety and pride. The proportion of students who said they felt safe at school most or all of the time increased from 57% to 87%. The proportion of students who said they felt proud of their school increased from 43% to 77%.

## **TEACHER PERCEPTIONS**

Studies have found that teacher satisfaction is influenced by the condition of the school building (Cash & Twiford, 2010; Filardo, 2008; Rudd et al., 2008).

- Corcoran and colleagues (1988, as cited in US Department of Education, 2000) reported that the physical condition of the school building had a direct effect on teacher morale, sense of personal safety, feelings of effectiveness in the classroom, and on the general learning environment. The researchers also found that “where the problems with working conditions are serious enough to impinge on the work of teachers, they result in higher absenteeism, reduced levels of effort, lower effectiveness in the classroom, low morale, and reduced job satisfaction. Where working conditions are good, they result in enthusiasm, high morale, cooperation, and acceptance of responsibility.”

- Researchers have found that control over environmental factors in the classroom has a strong influence on teacher morale. Teachers who have the ability to control light levels, sun penetration, acoustical conditions, temperature, and ventilation consistently report higher levels of job satisfaction (Buckley et al., 2004; Schneider, 2002; U.S. Department of Education, 2000).

## **TEACHER RETENTION**

Researchers have concluded that the physical condition of the school facility is an important predictor of teachers' decisions to leave their current position. Studies have consistently found that quality teachers are attracted to and remain longer at higher quality school buildings (Yeoman, 2012; Filardo et al., 2011; Buckley et al., 2004).

- Buckley and colleagues' (2004) study of Washington, DC teachers found that the quality of the school facility was one of many factors influencing teacher retention rates. The researchers reported that the physical condition of the school facility was a significant predictor of retention rate. As the perceived quality of the school improved, the probability of retention increased. In fact, the poor physical condition of a facility played a larger role in teachers' decisions to leave a school than dissatisfaction with pay.
- Among Washington, DC and Chicago teachers who graded their schools as a "C" or lower, more than 40% said that poor conditions led them to consider changing schools and 30% were thinking about leaving the teaching profession. The percentages were even higher for teachers who had experienced health problems related to substandard school buildings: approximately 65% of such teachers in Washington, DC and 50% of teachers in Chicago reported that they were considering changing schools; and approximately 40% of the teachers in both cities said they were thinking about leaving the teaching profession (Schneider, 2003).

## **SUMMARY**

Millions of students attend structurally deteriorating schools that put their health and safety at risk on a daily basis. Substandard school buildings frequently have unsafe drinking water, moldy environments, inadequate fire alarms and fire safety, inadequate ventilation, insufficient lighting, noisy classrooms, no wiring for technology, peeling paint, and crumbling plaster. Numerous studies have concluded that students in substandard school buildings perform at lower levels than students in newer, functional buildings. Researchers have found that students in deteriorating school buildings score between 5 to 11 percentile points lower on standardized achievement tests than students in modern buildings, after controlling for income level. Studies indicate that specific building conditions, including poor air quality, excessive temperatures, poor lighting, and high levels of noise, contribute to lower levels of student performance. Deteriorating schools have also been found to have a negative impact on student and teacher morale and have been linked to higher levels of teacher turnover.

## REFERENCES

- American Federation of Teachers. (2006). *Building Minds, Minding Buildings: Turning Crumbling Schools into Environments for Learning*. Retrieved from <http://www.aft.org/pdfs/psrp/bmmbcrumbling1106.pdf>.
- Baker, L., & Bernstein, H. (2012). *The Impact of School Buildings on Student Health and Performance: A Call for Research*. McGraw-Hill Research Foundation, New York, NY. Retrieved from <http://www.mcgraw-hillresearchfoundation.org/wp-content/uploads/2012/02/GreenSchoolsWP-2012.pdf>.
- Buckley, J., Schneider, M., & Shang, Y. (2004). *The Effects of School Facility Quality on Teacher Retention in Urban School Districts*. National Clearinghouse for Educational Facilities, Washington, DC. Retrieved from <http://www.ncef.org/pubs/teacherretention.pdf>.
- Cash, C., & Twiford, T. (2010). *Improving Student Achievement and School Facilities in a Time of Limited Funding*. Retrieved from <http://cnx.org/content/m23100/latest/>.
- Earthman, G.I. (2004). *Prioritization of 31 Criteria for School Building Adequacy*. American Civil Liberties Union Foundation of Maryland, Baltimore, MD. Retrieved from [http://www.schoolfunding.info/policy/facilities/ACLUfacilities\\_report1-04.pdf](http://www.schoolfunding.info/policy/facilities/ACLUfacilities_report1-04.pdf).
- Filardo, M. (2008). *Good Buildings, Better Schools: An Economic Stimulus Opportunity with Long-Term Benefits*. Economic Policy Institute Briefing Paper #216. Retrieved from <http://www.21csf.org/csf-home/publications/GoodBuildingsBetterSchools-EPI-Paper.pdf>.
- Filardo, M.W., Vincent, J.M., Sung, P., & Stein, T. (2006). *Growth and Disparity: A Decade of U.S. Public School Construction*. Building Educational Success Together, Washington, DC. Retrieved from <http://www.21csf.org/csf-home/publications/BEST-Growth-DIsparity-2006.pdf>.
- Filardo, M., Bernstein, J., & Eisenbrey, R. (2011). *Creating Jobs Through FAST!, a Proposed New Infrastructure Program to Repair America's Public Schools*. 21<sup>st</sup> Century School Fund Washington, DC. Retrieved from <http://www.21csf.org/csf-home/publications/FixAmericasSchoolsTodayFAST!.pdf>.
- Hatfield, M. (2011). *School Facilities and Student Achievement*. Center for Innovative School Facilities, Portland, OR. Retrieved from [http://www.cisforegon.org/current/documents/PolicyBrief\(8.5x11\).pdf](http://www.cisforegon.org/current/documents/PolicyBrief(8.5x11).pdf).
- International Centre for Indoor Environment and Energy. (2009). *Indoor Environment and Learning in Schools: Preliminary Results of Studies Investigating the Effects of IEQ on the Performance of Schoolwork by Children*. Technical University of Denmark, Lyngby, Denmark. Retrieved from [http://www.iciee.byg.dtu.dk/Research/Indoor\\_environment\\_and\\_learning\\_in\\_schools.aspx](http://www.iciee.byg.dtu.dk/Research/Indoor_environment_and_learning_in_schools.aspx).
- Rudd, P., Reed, F., & Smith, P. (2008). *The Effects of the School Environment on Young People's Attitudes Toward Education and Learning*. National Foundation for Educational Research, Slough, Berkshire, England. Retrieved from <http://www.nfer.ac.uk/nfer/publications/BSY01/BSY01.pdf>.

Schneider, M. (2002). *Do School Facilities Affect Academic Outcomes?* National Clearinghouse for Educational Facilities, Washington, DC. Retrieved from <http://www.ncef.org/pubs/outcomes.pdf>.

Schneider, M. (2003). *Public School Facilities and Teaching: Washington, DC, and Chicago*. Retrieved from [http://www.21csf.org/csf-home/Documents/Teacher\\_Survey/SCHOOL\\_FACS\\_AND\\_TEACHING.pdf](http://www.21csf.org/csf-home/Documents/Teacher_Survey/SCHOOL_FACS_AND_TEACHING.pdf).

U.S. Department of Education. (2000). *Impact of Inadequate School Facilities on Student Learning*. Retrieved from <http://www2.ed.gov/offices/OESE/archives/inits/construction/impact2.html>.

Wilson, A. (2008). Fix or Flatten? *American School Board Journal*, October 2008, 24-25.

Yeoman, B. (2012). Special Report: Rebuilding America's Schools. *Parade Magazine*, August 12, 2012. Retrieved from [http://www.rockinst.org/newsroom/news\\_stories/2012/2012-08-12-Parade\\_Magazine.pdf](http://www.rockinst.org/newsroom/news_stories/2012/2012-08-12-Parade_Magazine.pdf).