

# **Windows and Classrooms: A Study of Student Performance and the Indoor Environment**



## **TECHNICAL REPORT**

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## EXECUTIVE SUMMARY

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This study investigates whether daylight and other aspects of the indoor environment in elementary school student classrooms have an effect on student learning, as measured by their improvement on standardized math and reading tests over an academic year. The study uses regression analysis to compare the performance of over 8000 3<sup>rd</sup> through 6<sup>th</sup> grade students in 450 classrooms in the Fresno Unified School District, located in California's Central Valley. Statistical models were used to examine the relationship between elementary students' test improvement and the presence of daylight in their classrooms, while controlling for traditional education explanatory variables, such as student and teacher demographic characteristics. Numerous other physical attributes of the classroom were also investigated as potential influences, including ventilation, indoor air quality, thermal comfort, acoustics, electric lighting, quality of view out of windows, and the type of classroom, such as open or traditional plan, or portable classroom.

### *Previous Studies*

This study is the third in a series of studies looking at the relationship between daylighting and student performance. The first, *Daylighting in Schools*,<sup>1</sup> which was completed for Pacific Gas and Electric in 1999, examined school districts in three states. In Seattle, Washington and Fort Collins, Colorado, where end-of-year test scores were used as the outcome variable, students in classrooms with the most daylighting were found to have 7% to 18% higher scores than those with the least. In San Juan Capistrano, California, where the study was able to examine the improvement between fall and spring test scores, we found that students with the most daylighting in their classrooms progressed 20% faster on math tests and 26% faster on reading tests in one year than in those with the least.

A second study, the *Daylighting in Schools Reanalysis Report*<sup>2</sup> completed for the California Energy Commission in 2001 further investigated the results from the Capistrano school district. We investigated whether better teachers were being stationed in more daylit classrooms, and thereby inflating the importance of the daylight variable. In that district, we found that there was no assignment bias of better teachers to more daylit classrooms. Furthermore, the addition of information about teacher characteristics to the original student performance models did not reduce the significance or magnitude of the daylight variables. Among twelve models considered in that study we identified a central tendency of a 21% improvement in student learning rates from those in classrooms with the least amount of daylight compared to those with the most.

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<sup>1</sup> Heschong Mahone Group (1999). *Daylighting in Schools*. An investigation into the relationship between daylight and human performance. Detailed Report. Fair Oaks, CA.  
([http://www.h-m-g.com/Daylighting/daylighting\\_and\\_productivity.htm](http://www.h-m-g.com/Daylighting/daylighting_and_productivity.htm))

<sup>2</sup> Heschong Mahone Group (2001) *Re-Analysis Report, Daylighting in Schools*, for the California Energy Commission, published by New Buildings Institute, [www.newbuildings.org](http://www.newbuildings.org)