

Indoor Air Quality and Student Performance

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Governments generally devote a large share of public budgets to construct, repair and modernize school facilities. However, little is known about whether changes in the physical state of schools translate into student achievements. In this study, we report the results of a large field study, providing quasi-experimental evidence on the impact of environmental quality inside classrooms on learning outcomes. Indoor environmental quality is considered a key performance measure of school infrastructure, and a common indicator guiding investments in school facilities. We employ continuous sensing technology over three school years, installed in 280 classrooms across 26 elementary schools in the Netherlands, and use the Dutch standardized elementary school testing system to measure learning outcomes. This allows us to investigate the relationship between different aspects of indoor environmental conditions – temperature, CO₂, fine particles, humidity – and the performance of 9,000 children between ages 7 and 12 in over 27,000 tests. Using a fixed-effects strategy, relying on within-pupil changes in environmental conditions, we find significant underperformance in testing scores for children who have been chronically exposed to adverse indoor climate conditions in the semester preceding the test, with exposure to high CO₂ levels being most salient. We document that, at the time of testing, indoor climate conditions also affect student performance, again with CO₂ levels driving the results. A potential mechanism for the learning effects may be that adverse indoor climate conditions during part of the day lead to significantly longer breaks, reducing learning time in the classroom. Our results add to the ongoing debate on the determinants of student human capital accumulation, highlighting the role of physical capital in affecting learning outcomes.