

## iAQ Modules in Classrooms Can Help Schools Save Money and Improve Academic Performance

Poor air quality in the classroom can negatively affect academic performance by reducing a student's attention span. It can also reduce the quality of onsite instruction delivered by the teacher. According to the Indoor Air Quality Scientific Findings Resource Bank, in classrooms where ventilation rates are at or below minimum standards, student performance increases between five and ten percent when the ventilation rate is doubled.

Poor air quality can also have financial implications. Students and teachers who spend the majority of their day inside inadequately ventilated classrooms are more likely to develop related health issues. In school districts where government resources are linked to student attendance, an increase in the number of student absences results in decreased funding, while more teacher absences result in higher expenses. In a study of an elementary classroom, an increase in ventilation of one cubic foot per minute resulted in an estimated one-half to two-percent decrease in student absence rates.

Clean air is comprised of 21 percent oxygen, 78 percent nitrogen and one percent argon. Indoor air, however, is often contaminated with odors and potentially harmful mixed gases called volatile organic compounds (VOCs). Figure 1 shows the sources of the most common chemical groups of these VOCs. Occupied classrooms are especially prone to high concentrations of bio-effluents (VOCs from human respiration, transpiration and metabolism). If left unchecked, VOCs can result in a condition



known as “Sick Building Syndrome.” When a building is “sick,” some occupants will experience a variety of physical symptoms – eye irritation, headache, drowsiness or dizziness – while in the building. These symptoms usually subside after occupants leave the building. If the symptoms reoccur often and are experienced by numerous occupants, complaints eventually reach the facilities manager, or in the case of a school building, the principal.

### Demand controlled ventilation: A lesson learned

In a typical inadequately ventilated classroom, the amount of VOCs in the air can rise to unhealthy levels even before students begin their first lesson of the day. This not only negatively affects the students' ability to learn, but is also uncomfortable and detrimental to the health of both students and teachers. A constant supply of clean, fresh air is imperative.

AppliedSensor's intelligent Indoor Air Quality (iAQ) modules alert a classroom's ventilation system within seconds of detecting a level of target gases that have exceeded healthy thresholds. The iAQ modules are equipped with micro-machined metal oxide semiconductor (MOS) sensor elements to detect a broad range of VOCs and correlate these measurements with CO<sub>2</sub> levels, thus providing easy-to-interpret results that are compatible with industry standards. In addition, the modules feature low-power consumption, auto-calibrating sensing technology for maintenance-free operation, and can significantly reduce utility costs by signaling fans to turn on when VOCs are present and off when air quality returns to normal.

**Figure 1 – Examples of VOCs and Sources**

Substance Group	Example	Sources
Alkanes	heptane, methane	human breath, bio-effluents
Alcohols	alcohol, mineral spirits	cleaning supplies
Aldehydes	formaldehyde	building materials
Ketones	butanone	paints
Esters	methyl acetate	glues
Terpenes	pinene	perfumes and glues
Aromatics	xylol	paints and glues

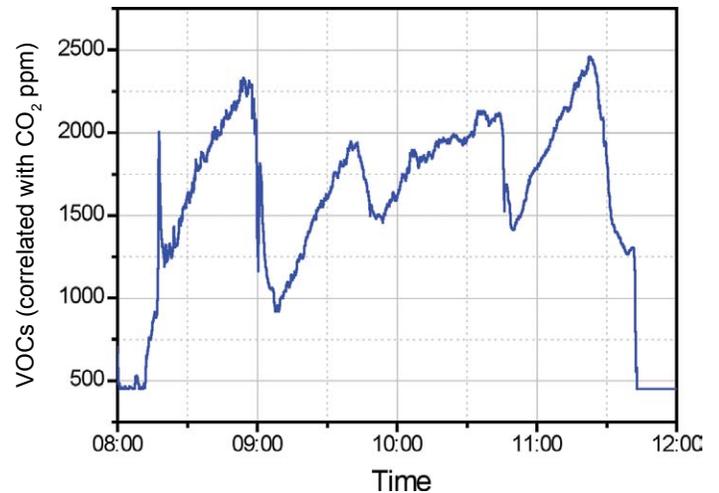
Source: AppliedSensor

## Unhealthy air typical in unventilated classrooms

Figure 2 illustrates the fluctuation in air quality in a typical 700-square-foot classroom (60-70m<sup>2</sup>) with 20 to 30 occupants and an inadequate ventilation system. Healthy thresholds are exceeded within a matter of minutes after the students arrive at 8 a.m. The measured values of VOCs in the classroom (correlated to parts-per-million of carbon dioxide (CO<sub>2</sub>)) continues to increase during the first hour – a peak time for quality instruction when students' attention spans are highest. Slight improvements in air quality over the next few hours result from doors being opened for breaks or recess. However, as VOCs build up over time, pollution increases and air quality continues to degrade, reaching the unhealthiest levels just before students are dismissed for lunch.

For the most part, the amount of VOCs in the classroom air have exceeded the standard healthy threshold limit all morning. If, however, an AppliedSensor iAQ module is installed, it will signal the building's HVAC or climate control system to turn on ventilation fans within moments of detecting an unhealthy level of VOCs, thus enabling students to continue their studies in a room filled with clean air.

In addition to reducing the number of absences and improving students' ability to learn and teachers' ability to teach, the subject of indoor air quality and "green" buildings could also be used as a topic to help students stay engaged. Subjects such as environmental science, chemistry, math and statistics present numerous opportunities for themed curricula about the importance of clean air and the adverse effects of polluted indoor environments.



**Figure 2 – Fluctuation in air quality in a typical 700-square-foot classroom (60-70m<sup>2</sup>) with 20 to 30 occupants**

Source: AppliedSensor



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