American Lung Association.

Data-Driven Indoor Air Quality in Schools

A Case Study in Assessing IAQ in a Small School District

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Indoor air quality (IAQ) is a critical component of a healthy learning environment. Americans spend approximately 90% of their time indoors, and children spend a significant portion of their waking hours in schools, where indoor air is two to five times more polluted than outdoor air. Children and those with underlying health conditions are especially vulnerable to pollutants like chemicals, allergens, particulate matter, and viruses.

Poor IAQ in schools increases the spread of airborne illness, decreases academic performance, diminishes work productivity, and increases absenteeism. Schools present unique IAQ challenges due to their high occupancy density, diverse chemical usage (from kitchens to science labs), and complex shared heating, ventilation, and air conditioning (HVAC) systems. Furthermore, an estimated 50% of U.S. schools struggle with outdated HVAC systems and an equal number lack formal IAQ management plans.

This case study partnership between Lakes International Language Academy, Carrier, and the American Lung Association conducted an IAQ assessment of one district. The goal was to establish a process for American Lung Association to partner with small school districts to conduct IAQ assessments, provide technical assistance, and develop written IAQ management plans.

Lakes International Language Academy (LILA) is a pre-Kindergarten – 12th grade International Baccalaureate World school in Forest Lake, Minnesota comprised of three campuses: Kinder Center, Lower School and Upper School. LILA serves 1,400 students. Like many other schools, the COVID-19 pandemic heightened awareness of IAQ issues among LILA leadership, who has a strong awareness of the built environment's impact on health and academic performance. LILA administration sought to leverage this collaborative project to establish data-driven IAQ practices and enhance equipment maintenance planning, while navigating resource constraints and continuing its tradition of transparent communication.

"We focused our attention on air quality during the pandemic. We leveraged indoor air quality science to the best of our ability to keep people healthy in our school spaces." — LILA Administrator

Methods

The district's IAQ was assessed in the fall of 2024 to inform recommendations for improvement and sustainability.

1. 137 **continuous air quality monitoring sensors** were installed throughout the three (3) LILA campuses. Each sensor collected five (5) IAQ parameters: carbon dioxide (CO_2), particulate matter (PM2.5), volatile organic compounds (VOCs), temperature and relative humidity. Data was filtered to include only the schools' operating hours. Results were analyzed and a detailed report on the findings was provided to LILA.
2. **Building walkthroughs** were conducted on two campuses (Kinder Center and Lower School) using EPA's Tools for Schools Action Kit checklist.
3. **Teacher Surveys** were electronically completed by Lower School and Kinder Center faculty in using a modified EPA's Tools for Schools "Teachers' Classroom" checklist.
4. **Key informant Interviews** with LILA administration were held at the onset of this project to collect baseline information about IAQ history, practices and procedures.

Results

1. LILA's clean air exchange rate is higher than recommended on all three (3) campuses. Air Changes per Hour (ACH) is the number of times the entire volume of air in a room is replaced with fresh air in one hour. The CDC recommends a minimum of five (5) ACH per hour in occupied spaces.
2. LILA had institutionalized practices for monitoring and maintaining systems which impact IAQ. The district assesses and maintains their HVAC systems, monitors the number of air exchanges daily and changes air filters 3-4 times per year. They regularly conduct asbestos inspections and have tested for radon and mold within the last 5 years.
3. LILA had taken recent action to eliminate water and moisture entering the Kinder Center basement classrooms. No mold was observed during building walkthroughs.
4. Temperature and carbon dioxide (CO_2) levels measured by IAQ sensors occasionally fell outside of the recommended levels. The Occupational Safety and Health Administration (OSHA) recommends temperatures in the range of 68 to 76° F. The American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE) recommends CO_2 concentrations under 1,000 parts per million (PPM).
    a. One out of 4 classrooms registered temperatures outside of the recommended range 20% of the occupied time or more.
    b. Some classrooms (34%) in the Kinder Center and Lower Campus experienced elevated levels of CO_2. This occurred 20-27% of the occupied time, primarily between the hours of 2 & 5 pm. While it is not surprising that CO_2 levels elevate throughout the school day, findings suggest an opportunity to adjust HVAC systems to increase ventilation rates.
5. Satisfactory classroom conditions were found during the walkthrough assessments. Classrooms were well-maintained and free from sources of pollution, including trash, animals, active leaks or condensation or pests. A few classrooms had upholstered chairs, and some cleaning supplies were present including antibacterial wipes.
6. Two types of odors were identified through the school assessment. A couple of teachers reported occasional odors from vehicle exhaust, but these conditions were not observed during building walkthroughs. The vehicle exhaust could be explained by car emissions seeping indoors during parent drop-off or pick-up idling times. There was a notable odor from a laminator in one workroom, indicating possible presence of VOCs.


Lessons Learned

This comprehensive IAQ assessment yielded valuable insights that can inform future IAQ management strategies for LILA and serve as a model for similar assessments in other schools.

Teacher surveys and building walkthroughs provide contextual insights: the combination of sensor data with teacher surveys and building walkthroughs provided a comprehensive understanding of IAQ. Teacher surveys offered valuable insights into potential pollution sources and perceived IAQ issues, while building walkthroughs confirmed classroom conditions and identified potential problem areas. This multi-faceted approach to assessing IAQ is key.

Real-time data enhances operational control: utilizing continuous IAQ sensors provided granular, real-time data on IAQ conditions. This data has allowed for a more precise understanding of IAQ fluctuations throughout the day and across the three campuses. Facilities staff emphasized the value of this data for making informed decisions regarding HVAC adjustments and outdoor air intake management.

Occupancy and time-of-day impact on IAQ: sensor data revealed that CO_2 levels tended to rise in classrooms during the later hours of the school day, particularly between 2 and 5 pm, as a result of ongoing occupancy. Schools should consider adjusting HVAC schedules to address these fluctuations.

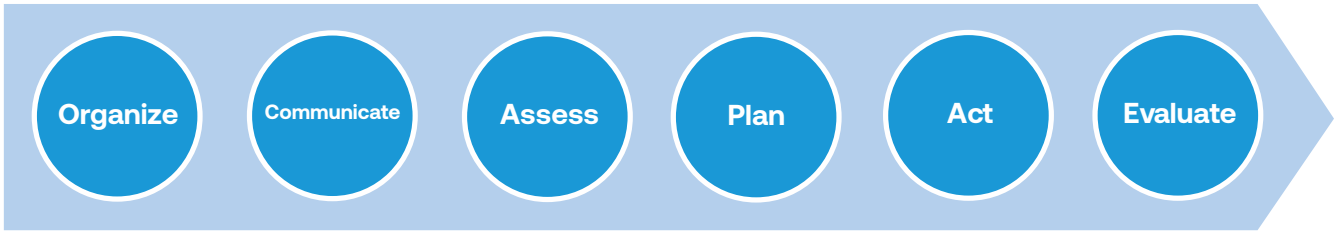
Targeted interventions address specific pollutant sources: while overall IAQ at LILA campuses was satisfactory, the identification of specific pollutant sources, like vehicle exhaust and cleaning supplies, demonstrate the importance of targeted interventions. Addressing these sources through strategies like anti-idling policies and district-approved cleaning products can further enhance IAQ.

Resource constraints require strategic planning: LILA's experience in navigating resource constraints while enhancing IAQ practices underscores the need for strategic planning and prioritization. Schools with limited resources can leverage data-driven approaches and targeted interventions to maximize the impact of their IAQ management efforts.

Looking Forward

EPA's Tools for Schools presents a framework for schools to effectively address IAQ management. Through this partnership, LILA has organized, communicated with its community, and assessed its IAQ.

Utilizing assessment results and recommendations, LILA will continue their commitment to IAQ and develop a written IAQ Management Plan that outlines policies and institutionalizes their existing procedures to maintain and improve IAQ.



For more information about clean air at schools, visit Lung.org/CASC.

American Lung Association

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