

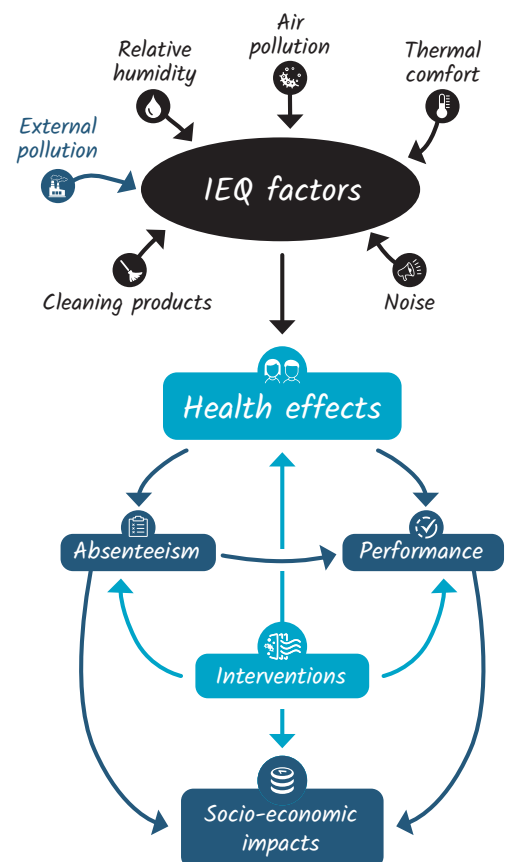


IMPACT OF INDOOR ENVIRONMENTAL QUALITY IN EDUCATIONAL BUILDINGS ON HEALTH, WELLBEING, AND PERFORMANCE

Poor indoor environmental quality (IEQ) in educational buildings can be harmful to young people's health, wellbeing and academic performance.

UKHSA and Eurovent carried out a scoping review to establish how IEQ factors such as air pollution, thermal comfort, relative humidity and noise in schools, kindergartens and colleges can affect young people's health, learning and academic performance. Negative health effects can be exacerbated indoors by the presence of outdoor and indoor sources of pollution, as well as the condition and operation of the building or ventilation systems.

Based on studies from high-income countries, this review evaluated relationships between health, absence and performance effects, and methods of quantifying socioeconomic impacts of improving IEQ in these spaces. This can help inform future assessments of interventions, such as source control, building renovation, using air conditioning and cleaning technologies in educational buildings.



Key recommendations for local governments:

- Implementing current national regulations for ventilation – maintaining carbon dioxide (CO₂) below 1000ppm;
- Prioritising funding for education, to improve building condition, ventilation provision and maintenance, as well as staff training on the use of new systems;
- Putting existing knowledge into practice on local scales, e.g., working with stakeholders (local authorities, headteachers and parent groups) to encourage behavioural change.

Key recommendations for school staff:

- Minimising sources of indoor pollutants through changes to quantity and timing of use of cleaning products, classroom / lab / IT equipment.
- Increasing ventilation rates, by opening windows, where secure and safe, or using mechanical ventilation, where available.
- Using air cleaners where needed, with regular maintenance.



How could better IEQ in educational buildings benefit young people?

Health impacts

Reducing pollutants (such as volatile organic compounds (VOCs), particulate matter (PM) and nitrogen dioxide (NO₂) in the classroom can reduce risk of developing or exacerbating respiratory issues, such as asthma and allergic rhinitis, wheezing, and more specific non-respiratory symptoms (e.g., nasal allergies, dermatitis, neurotoxicity).

Absenteeism

Increasing ventilation: fewer days of school missed (e.g., up to 5.8% decrease for each unit (1 litre/second/person) increase in outdoor air supply [1]);

Reducing overheating in classrooms (e.g., from 30 °C to 27 °C) could decrease absenteeism by nearly 22% [2];

Pollutants (e.g., PM, NO₂, sulphur dioxide and mould) are associated with absenteeism;

Performance and attainment

Reduced indoor air pollutants: improve development of working memory with lower NO₂, elemental carbon and ultra-fine PM concentrations.

Reducing CO₂ concentrations: to within ventilation standards (below 1000ppm) can improve speed and accuracy of task completion, and performance in national tests by 5% [3].

Increasing air flow (e.g. up to 8.5 l/s/person) can improve speed of reading & comprehension, subtraction and logical reasoning tasks by 25% [4].

Room temperature: Mathematics test scores improved when temperature decreases, e.g., from 25 °C to 20 °C [5], and optimal temperature for learning is around 22 °C [6].

How could better IEQ in educational buildings benefit society?

 Socio-economic benefits from **better academic attainment** and **reduced healthcare costs** can outweigh capital and running costs of improved ventilation systems.

Ventilation and building envelope improvements could prevent **676 cases of asthma** (per 100,000 children), saving the NHS over **£64,000/year/UK region** [7].

Gross Domestic Product (GDP) and public finances estimated to **improve by €173 mil per annum** and **€37 million per annum** respectively, upon increasing ventilation rates 8.4 l/s/person (Denmark) [8].

Annual benefit of reduced healthcare costs upon achieving WHO indoor guidelines for PM estimated at **€31 billion** across Europe [9,10].

How to improve IEQ in educational buildings?

 Minimising sources of pollutants in building, furnishing and cleaning materials, IT and lab equipment – e.g., using smaller quantities or low-emission ‘green’ products - can be effective at reducing concentrations of pollutants such as VOCs and PM.

 Where sources cannot be controlled, ventilation is key. Older buildings that rely on window-opening are at risk of inadequate IEQ from bringing in cold air to reduce pollution, especially if outdoor air is polluted. Security issues need to be considered.

 Mechanical ventilation and high efficiency particulate air (HEPA) filtration are better at maintaining good classroom IEQ, reducing PM and VOCs such as formaldehyde by up to 45%, and reducing respiratory virus transmission.

Grassie D, Milczewska K, Renneboog S, Scuderi F, Dimitroulopoulou S. **Impact of Indoor Air Quality, Including Thermal Conditions, in Educational Buildings on Health, Wellbeing, and Performance: A Scoping Review.** *Environments*. 2025; 12(8):261. <https://doi.org/10.3390/environments12080261>

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