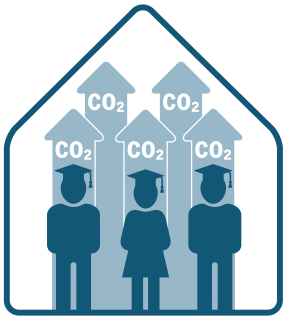
Fraunhofer IBP

Indoor Air Quality in European Schools

There are currently **95,000,000 pupils** in Europe[1].

As children spend around **70%** of their time indoors, a good learning environment is **crucial**.

CO_2 concentration in classrooms



Although there have been improvements to school buildings in recent years, many classrooms still don't provide an optimum indoor environment for learning.

Studies have reported that many schools have CO_2 levels above the recommended range of 1,000 to 2,000 ppm[3].

CO_2 Recommended levels of CO_2

As classrooms are densely occupied spaces with a metabolic production of CO_2 by the occupants, the CO_2-concentration is directly dependent on the ventilation rate.

Recommended values lie between **1,000-2,000 ppm**. While levels below 1,000 ppm are considered as hygienically unproblematic, levels above 2,000 ppm are hygienically unacceptable[2].

Improved indoor air quality = Improved performance

An average increase in performance by 2.8%, and even 15% in specific cases[4]

Increased speed

Higher levels of attention and concentration

Lower rates of absenteeism

Increase in performance = economic growth

An increase of school childrens' performance by 2.8% would lead to a 6.7% - 9.5% increase in the conditional economic growth of the country (based on GDP per capita)[4, 5].

How to improve the indoor air quality in classrooms

As most schools in Europe have been designed for natural ventilation, more time should be set aside for airing during lessons.

Innovative natural ventilation solutions, e.g. demand-controlled natural ventilation, can maintain the CO_2 level within the recommended range.

Mechanical ventilation systems can ensure an optimum level of air quality without compromising thermal comfort in colder months.

Hybrid solutions can combine the advantages of both natural and mechanical ventilation.

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[1] Eurostat: Education Statistics, Distribution of pupils/ Students by level [educ_ilev], extracted on: 21.06.2015.
[2,3] Umweltbundesamt: Gesundheitliche Bewertung von Kohlendioxid in der Innenraumluft. In: Bundesgesundheitsblatt – Gesundheitsforschung – Gesundheitsschutz 51(11) (2008), p. 1358–1369.
[4] Fraunhofer-Institut für Bauphysik IBP, Impact of the indoor environment on learning in schools in Europe, December 2015
[5] The conditional growth calculation is based on the research of Hanushek, Eric A., and Ludger Wößmann. 2007. "The Role of Education Quality in Economic Growth." Policy Research Working Paper 4122, World Bank, Washington, D.C. This was related to an increase by 2.8% in PISA test scores for maths and reading.

Infographic based on the following White Paper: Fraunhofer-Institut für Bauphysik IBP, *Impact of the indoor environment on learning in schools in Europe, December 2015*