

## IS INDOOR ENVIRONMENTAL QUALITY IN MY SCHOOL CLASSROOM SAFE?

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Pawel Wargocki ([DTU SUSTAIN](#) and Technical University of Denmark)

Prof. Pawel Warwocki is best known for his work demonstrating that poor indoor environmental quality affects work and learning. Recent research includes studies on emissions from humans and the performance of green buildings. He is a current member of DTU Sustain, one of Europe's largest university departments specialising in environmental and resource engineering that focuses on developing new, environmentally friendly and sustainable technologies, methods, and solutions.

A previous [blog](#) published by ODE focused on the importance of classroom environmental quality for children's health and learning. Children spend a substantial part of the day in school, sometimes up to 8–10 hours. With rising temperatures and other negative impacts of climate change, it is increasingly vital to ensure that classroom environments are comfortable spaces conducive to learning and active participation in school life. So how can we do this?

How can we monitor indoor environmental quality without access to sophisticated measurement instruments?

This blog highlights simple methods for checking classroom environmental quality. The methods cannot replace the processes of taking actual measurements and monitoring, or ensure that classrooms meet code requirements; they will, however, help identify particular problems and indicate actions that can be taken to avoid them. The end of the blog includes a table of the actions described and a simple survey that can be used with schoolchildren.

# ASSESSING THE QUALITY OF CLASSROOM ENVIRONMENTS

Below are some ways you can assess the quality of classroom environments without using sophisticated measurement tools.

## 1. Watch children in a class and ask them about their perceptions of the indoor environment

Indoor environmental parameters can affect children negatively or positively. The simplest way to find out whether classroom indoor environmental quality has risks for pupils is to observe pupils, their behaviour, and mood changes. Ask the children about the classroom conditions.



Bright light and noise can increase stress and disobedience and cause children to be more active, while high temperatures can make children less responsive or sleepy. Teachers can quickly identify their pupils' mood changes, which could be the first sign to watch out for, especially if they are also connected to perceived changes in classroom environmental quality. To document such changes, teachers can ask the children about their perception of the classroom environment and how they feel. To avoid bias and children in a class influencing each other, it is best to ask each child to answer questions on paper.
















Figure 1 provides an example of the kind of survey teachers could use. However, teachers can also discuss the questions with the class in a plenary session. The discussion can be an opportunity for a teaching and learning experience, resulting in suggestions for solutions, including changes in behaviour if the class is too noisy. At the very least, such an activity could raise awareness and encourage children to take action to improve the indoor environment of their classrooms. Children's responses usually address their immediate experiences; nevertheless, the survey could be an opportunity to gather students' perceptions of the environmental factors that have caused discomfort in the past.

Figure 1. Example survey to assess children's perceptions of classroom environment. *Source: Vasquez, N.G., et al. 2023. Ventilation strategies and children's perception of the indoor environment in Swedish primary school classrooms. Building and Environment.*

**10. In the classroom, I usually find that:**

It is too cold	not at all <input type="checkbox"/>	little <input type="checkbox"/>	very much <input type="checkbox"/>
It is too warm	not at all <input type="checkbox"/>	little <input type="checkbox"/>	very much <input type="checkbox"/>
It smells badly	not at all <input type="checkbox"/>	little <input type="checkbox"/>	very much <input type="checkbox"/>
There is disturbing sound/noise	not at all <input type="checkbox"/>	little <input type="checkbox"/>	very much <input type="checkbox"/>
There is poor light (too bright or too little light)	not at all <input type="checkbox"/>	little <input type="checkbox"/>	very much <input type="checkbox"/>

**11. I usually feel like this in the classroom: Circle a face.**

I feel good				I feel bad
I am alert				I am tired
I can focus/concentrate				I cannot focus/concentrate
I want/have desire to work				I do not feel like working
I have no headache				I have a headache

Conducting a survey may not always work, as sometimes children are not good 'monitors' of indoor environmental quality. Nevertheless, their ratings can raise red flags and initiate actions otherwise considered unnecessary.



## 2. Check the size of the class and the number of pupils

Finding out whether air quality in classrooms is adequate is probably one of the most challenging tasks. Air quality can depend on numerous factors and is difficult to evaluate, even using sophisticated instruments. However, simple observations and tests can give you some idea of likely risks. The first thing you can do is count the pupils and measure the classroom floor area.

Classroom design is usually based on a nominal number of pupils plus teacher(s) to area. Generally, one person per two square meters is considered an acceptable ratio. However, classrooms are frequently much more crowded. So, one way of checking whether there is a potential problem with air quality is to determine whether the classroom size is adequate for the number of pupils. If not, issues relating not only to air quality but also overheating and noise can arise. The task is to ensure that the classroom area is appropriate for the number of pupils.

Staying inside a classroom for extended periods makes our sense of smell dormant due to so-called 'sensory fatigue'. This makes it difficult to determine whether the air in the classroom is fresh or stale, or if there is an increased intensity of odours. An easy way to check for air quality is to leave the classroom for a few moments, refresh your sense of smell by breathing in clean outdoor air, and re-enter the class; this can also be done towards the end of a lesson once pupils have left, or before or during a new lesson. If the odour is distinct and the air feels unpleasant and stuffy, this indicates poor classroom ventilation. Poor ventilation has been documented to reduce concentration and learning and increase health risks.

Often, some odours can persist, even in unoccupied classrooms. An example can be the odour of building materials, sealants, or mould. This indicates a potentially serious problem that requires appropriate action, which can sometimes involve removing the source of the odour. In the case of mould, an inspection of surfaces can be made, but the mould might be hidden within the wall or floor structure and hence invisible.

Another marker of poor ventilation is condensation on windows during the cold season. Condensation can also be caused by poor insulation. In such circumstances, It is important to ventilate and air classrooms, as condensation can lead to other problems, such as an increased risk of mould. Classrooms with ventilation systems or shafts or grills to ensure adequate ventilation can also suffer from poor air quality if the systems are blocked or not functioning. To check if this is the case, place one layer of a paper napkin against the shafts or grills. If the napkin does not move or flutter, it suggests that there is no airflow and there is a malfunction. Unfortunately, when it comes to air quality, there is no simple, cost-free app or instrument that can be used for monitoring.



### **3. Open windows, but be aware of the potential risks**

Airing indoor spaces by opening windows or other outdoor openings may be the simplest solution to the above-mentioned problems. However, this may not always provide a solution. For example, air may flow outwards through an opening, and not into the class, which means that air from the other parts of a school could flow into the class; this air may not always be clean nor sufficient to reduce risks.

It is also important to bear in mind that outdoor air can be polluted, especially in cities close to traffic and industry, and outdoor temperatures can be low, causing cold drafts and thermal discomfort. So think carefully before using open windows for ventilation.

### **4. Check if the children in the last row can hear you**

Just as ventilation is essential for air quality, background noise and reverberation time (the time it takes noise to fade), can affect a classroom's acoustic environment. You need specialised instruments to measure and quantify both. Nonetheless, there are simple ways of identifying potential acoustic problems. A teacher can, quite simply, check if children sitting in the last rows of a class can hear the teacher when they are speaking. Trouble hearing a teacher in an otherwise quiet classroom may suggest issues with acoustics and the need for action. A background noise source might be down to equipment or come from outside. You can use a smartphone or tablet to make crude measurements of background noise without sophisticated instruments. The microphones on smartphones and laptops coupled with free apps allow for simple sound pressure measurements. These measurements can indicate potential problems, although microphones can introduce measuring errors. Background noise levels should be maintained below 35–40 decibels or dB(A); anything higher could be disruptive.

The simplest way to avoid problems with additional noise is to remove the source of the disturbance, e.g., by closing the windows if the noise source is outside or introducing soft materials to the classroom to stop the sound of a teacher's or pupil's voice fading away too quickly. Such steps can only serve as stopgaps, however, and proper measurements undertaken by a specialist would be necessary to ensure permanent solutions.

### **5. Ensure there is no glare**

Concerning the visual environment, glare, i.e., dazzling or blinding light, should be avoided. Visual observations are the only way to ensure there is no glare. The light in a classroom should be equally distributed. Minimum acceptable levels are 300–500 lux and, again, as in the case of noise,



can be crudely measured using smartphones or tablets as all of them have cameras and free apps that can make such measurements.

The easiest way to ensure proper illumination in a classroom can be by rearranging the layout of the desks. The important thing to ensure is access to daylight and avoiding glare or overheating (heat gains from the surfaces illuminated by the sun). As mentioned earlier, light and noise are powerful, stimulating factors, so observing pupils' behaviour can indicate potential problems. Dimmed light can cause children to be quiet, perhaps even sleepy, and very bright light can make them hyperactive.

## **6. Children can tell whether it is warm or cold**

Identifying issues with the thermal environment can be quite straightforward. Touching classroom walls during low temperatures outside can identify cold surfaces and potential cold draughts. An easy way to check whether thermal conditions are satisfactory is to touch children's hands. Cold hands, either during the winter or with air conditioning during summer, would suggest that temperatures are generally too low.

Children can better tolerate lower indoor temperatures indoors than adults, as they tend to be more active. Studies suggest that lower temperatures are beneficial for learning. However, too low temperatures, especially when there are also unwanted drafts, can compromise immune response and result in respiratory illnesses. The likelihood of drafts can be identified by observing papers on school desks – to check if they are moving or rustling. Noise from the grill of a ventilation system or air conditioner may also propose high air speeds and potential drafts. High temperatures, on the other hand, can make children sluggish and less active, and a teacher can see if this is the case by observation.

## **KEY TAKEAWAY:**

### **Simple methods are not a substitute for proper monitoring**

If you can identify problems related to environmental conditions in classrooms with the simple methods described above, you might well ask why we need sophisticated and expensive measurements, consultants, and lengthy monitoring.

The answer is simple. For schools to meet public health and occupational guidelines, requirements, and building codes, proper monitoring and measuring activities must follow proper

protocols. They cannot be avoided and should be undertaken repeatedly and regularly, not just once, e.g., during commissioning.

Only through regular monitoring can we ensure that all conditions and safety requirements are met and that the indoor environmental quality in classrooms is at its highest. However, these compulsory measurements do not preclude the simple observations and actions described above that can indicate concerns and initiate the proper course of action. These actions may start with simple and crude solutions, but can ultimately lead to more substantial retrofits that often require time and financing. In the meantime, there is a place for simpler, tentative solutions.

## SUMMARY

### Simple actions for identifying problems with classroom environmental quality

- Observe changes in children's behaviour
- Check the density of occupation
- Check for persistent odours and odours perceived upon entering the occupied classroom
- Check whether the technical systems are operating
- Check for condensation on windows and mould growth
- Download and use free apps to measure sound and illumination levels
- Check for glare and the time it takes for voices to fade out
- Rearrange tables and layout if necessary
- Check whether the children's hands are cold
- Touch surfaces to examine whether they are cold
- Observe whether papers are rustling and whether there is noise from technical equipment

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