

Let's clear the air

Exploring effects and awareness of
air quality in learning environments.
September 2021



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Introduction

Background and purpose

There has been a lot of discussion in recent years about what constitutes a good learning environment and how to give students the best possible prerequisites for absorbing knowledge and to develop their creative and collaborative capacities.

Although this topic has been examined from various academic perspectives, one aspect remains relatively unexplored. Interestingly, it might be one of the most fundamental ones: the air that we breathe.

The purpose of this study is thus to shed light on the role of air quality in creating good learning environments (with particular focus on lower secondary school/junior high school).

Setup and respondents

This study consists of four key components, all conducted from winter 2020 through spring 2021:

- A series of qualitative interviews with 8th grade students (14 years old), teachers of 8th grade classes, and principals at a school with 8th grade classes (all attending/employed at Enskede skola in Stockholm).
- A nation-wide quantitative survey with parents of 8th grade students, teachers of 8th grade classes, and principals at schools with 8th grade classes (a total of 300 respondents across Sweden).
- Three qualitative expert interviews (see below).

- A technical air quality test conducted in Enskede skola in Stockholm.

The study is conducted by Stockholm-based insight agency Augur specialized in research, analysis, strategy and innovation. Augur realizes projects in a number of different categories and industries, both in Sweden and internationally (www.augur.se).

Experts

As part of this study, we have received access to the brilliant minds of three experts who are prominent in their respective fields:

Anna-Sara Claeson

Docent at Umeå University with a background in chemistry in psychology, primarily focusing on interdisciplinary research in chemical exposure and building-related illness.

Katarina Gospic

M.D., Ph.D. in neuroscience and founder of Brainbow Labs, raising the general public's awareness about our brain and how we can co-exist with modern technology through innovation, books and lectures.

Malin Valsö

Psychologist, author and CEO at Elevhälsokonsulterna, helping schools, municipalities and other organizations to improve learning environments.

Prologue: We are the air we breathe

“The first and last thing we do as human beings, is breathe.”

Katarina Gospic, M.D. and Ph.D.

We come from fresh air

In the early stages of humankind, we lived our lives out in nature. The idea that our primordial state is a life outdoors – out in the fresh air – is deeply rooted in our collective mindset.

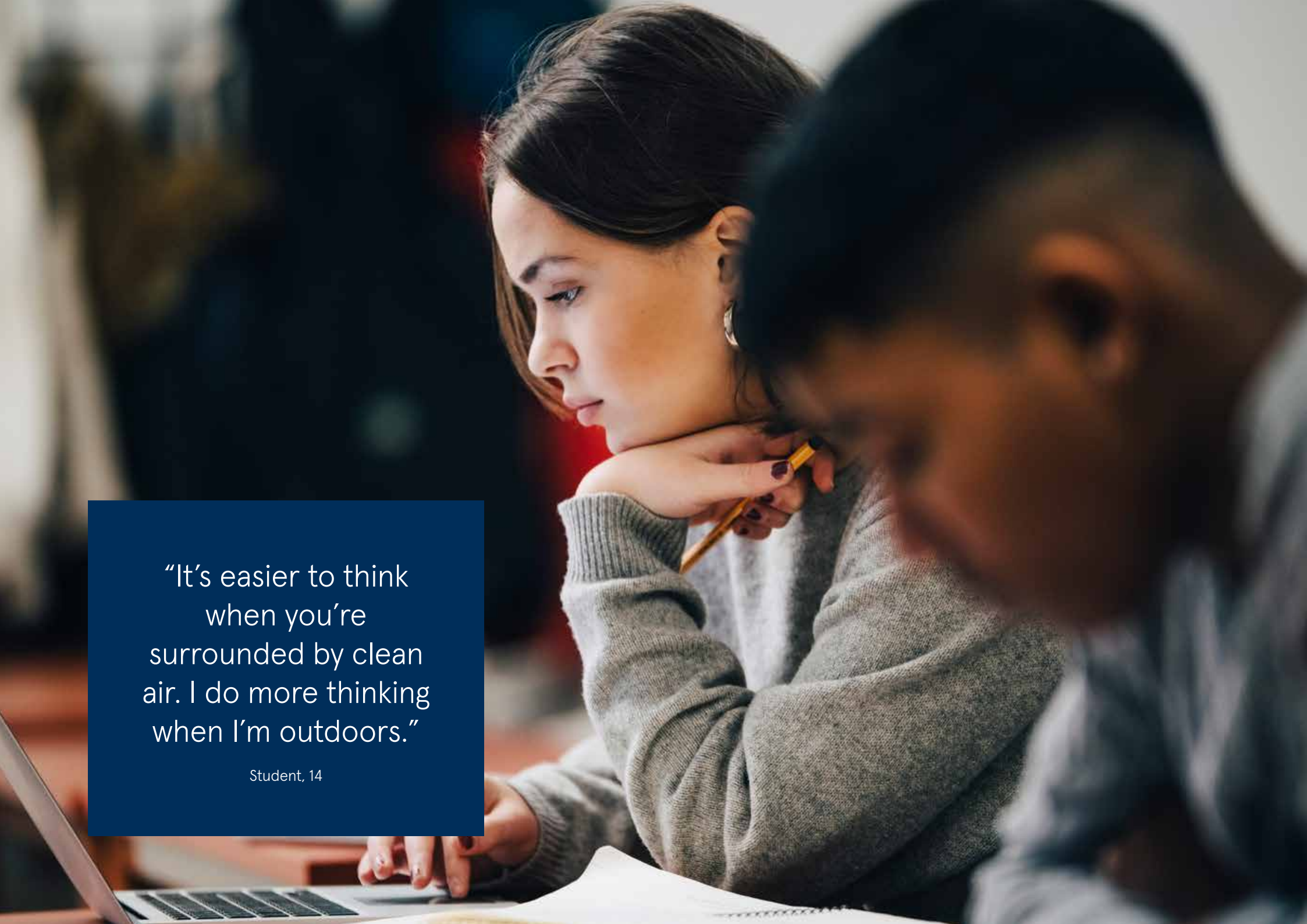
However, over millennia our habitats have changed. We have created increasingly advanced shelters, human life has moved from the open fields, dense forests, high mountains, breezy banks and beaches – to the indoor landscape.

Although our habitats look very different now, there is still a perception that our bodies are suited for a life in nature – with its seemingly unlimited supply of fresh air. Even though it’s been our primary home for centuries, the indoor environment is seen as a less natural place to live, at least in regard to the air we breathe.

Clean air equals fresh air

Clean air is strongly associated with the air one breathes in a forest or archipelago. Most respondents, students and





“It’s easier to think
when you’re
surrounded by clean
air. I do more thinking
when I’m outdoors.”

Student, 14

school staff alike, equate clean air with fresh air; air from environments where there's an abundance of trees or a large body of water.

"The air is fresher outdoors. You know how when you've been out in the forest, you feel all healthy afterwards. When you've been in your room all day, windows shut, you don't feel as good."

Student, 14

When asked whether outdoors or indoors air is of better quality, over 80% of respondents answer outdoors. In interviews with students and school staff, several examples are provided of how being outdoors has benefits for both our cognitive capabilities and our sense of well-being.

Some perceive crisp and cold air to be cleaner, or that air is cleaner when it's chillier.

Evidently, the cleanness of the air is associated with the context in which you breathe it – as well as how it smells and feels on your skin.

Regardless of where you think you are most likely to find it, clean air is seen as essential for cognitive capabilities, good health and a sense of well-being.

It should be noted that there are definitions of air quality that are rooted in science. Katarina Gospic, M.D. and Ph.D. in cognitive neuroscience, points to a definition from the World Health Organization:

"I would define poor air quality as the amount of hazardous particles in the air."

Katarina Gospic, M.D. and Ph.D.

Interestingly, in both cases there is a close relation between clean air and our health. Even though there are common misconceptions, as will be elaborated on in later chapters, there is a general understanding that we are highly affected by the air that we breathe.

Air quality in learning environments

“If we were to have classes outdoors, I think we’d feel healthier.”

Student, 14

Good air quality is a prerequisite for a good learning environment

There is a saying that goes: “first we learn to read, then we read to learn.” If learning capabilities are diminished – which they are by poor air quality – there is a risk of limiting the students’ future educational and professional opportunities.

Schools are supposed to provide safe, healthy, productive, and comfortable environments for students and staff.

Air quality is key for a good learning environment. However, ensuring good air quality in schools is not always easy. According to Sinphonie, the Schools Indoor Pollution and Health: Observatory Network in Europe, poor air quality is an issue in most schools.

As will be described in the next few chapters, poor air quality in schools has significant effects on both students and staff: it makes it more difficult for students to learn and for teachers to teach. Some effects are highly noticeable, whereas others go unnoticed – at least initially.

Poor air quality is an issue in Swedish schools

As a backdrop to the insights that follow, it should be pointed out that indoor air quality in Swedish schools is an issue. This has been noted by the Swedish Public Health Agency (Folkhälsomyndigheten) and the Swedish Work Environment Agency (Arbetsmiljöverket). In a 2015 study the former concluded that the air quality in 15% of Swedish schools is low enough to have a negative impact on students’ health.

NGOs and unions, for instance Svensk Ventilation, Astma- och allergiförbundet and Lärarförbundet, have worked actively to raise awareness of these problems and encourage politicians and authorities to address them more efficiently.

A recent test* done in three different classrooms of a suburban Stockholm school, shows that the amount of hazardous particles is well above the World Health Organization’s guidelines for safe air quality levels. According to these guidelines, indoor particle pollution levels above $15 \mu\text{g}/\text{m}^3$ make the air unhealthy to breathe. The air samples in above mentioned test show that the air in the classrooms contained 5–6 times higher value than WHO’s guidelines per 24 h (2021) for fine particles, $2,5 \mu\text{g}/\text{m}^3$.

* The test was conducted by Blueair technicians in February 2021, in Enskede, Stockholm, Sweden.

Students and teachers experience fatigue

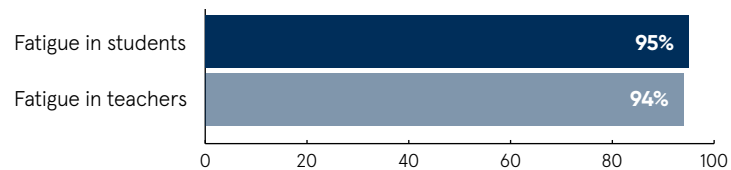
Both students and teachers experience feeling increasingly tired throughout the day, and admit to being significantly less attentive in the afternoon. While understanding that their sense of fatigue can be the result of several different factors, indoor air quality is believed to be one of the causes. Some go as far as to say they can feel the air shift; they physically notice the air quality drop as the day goes by.

“I get more tired and slow towards the end of the school day.”

Student, 14

Some students explicitly attribute their fatigue to poor air quality over the course of a day. They explain how the air in their classrooms feel increasingly stale and recycled. Some point out that this is particularly notable in smaller rooms (such as classrooms), air in more spacious rooms does not feel recycled to the same extent.

When asked about short-term effects of poor air quality, almost all respondents – parents, teachers and principals alike – think fatigue is one such effect.



Teachers also point to air quality when describing their sense of fatigue, but their experiences are more related to how the learning environment is affected (see below).

It should be noted that the fatigue experienced by teachers can also manifest itself in other settings throughout the workday. A school principal mentions that when the weekly teachers’ conference was moved from 4pm to 8am, there was a notable increase in how active, engaged and productive teachers were during the conferences. The air quality, presumably better in the morning, is believed to be one important cause of that.

Students can feel their learning capabilities drop

As the sense of fatigue grows, learning becomes more difficult.

“When I’m in the classroom and feel tired, it’s much harder to start with assignments. I also get irritated more easily, and more often I give up when something’s difficult.”

Student, 14

Students perceive that their learning abilities drop as they get more tired. Some also point out that, as they become increasingly tired, the classroom becomes rowdier and noisier. They admit that the self-control they can muster wears off when they get tired, leading to more chatting and restlessness. This makes it harder for everybody in the classroom to concentrate, listen, and carry out assignments.

Teachers point out educational challenges

Teachers explain that a fundamental element of teaching is a good relationship between teacher and student. To convey knowledge and understanding, teachers need to establish a solid bond to students. Some note that the key to teaching is also the main challenge: to inspire and motivate students.

To create a solid foundation for learning, teachers explain that students (and the teachers themselves) need to feel well and energized. If that need is not met, establishing a good relationship to students – as well as motivating and inspiring them – becomes harder.

Teachers know that students have limited capacities to stay attentive and focused, and poor air quality can further lower those capacities. As air quality decreases throughout the day, teaching becomes increasingly challenging.

These experiences are consistent with the results from a study conducted by Blueair in the UK, in which an overwhelming majority of teachers express that good air quality improves students' abilities to focus and learn.

Parents express concerns about air quality in schools

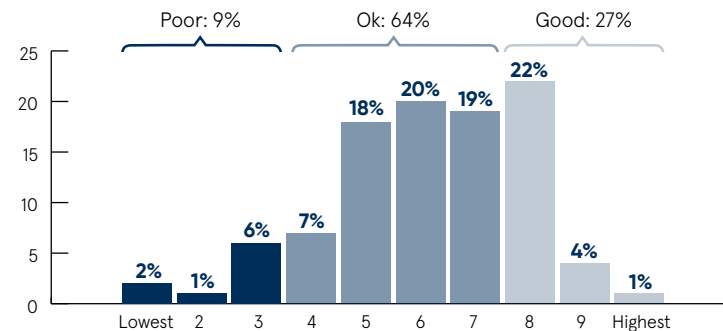
In general, it is not unusual for parents to express concerns about their children's wellbeing in school.

“We hear from parents who are worried that their children have to be in school buildings that might be bad for them.”

Sofia Stenberg, Principal

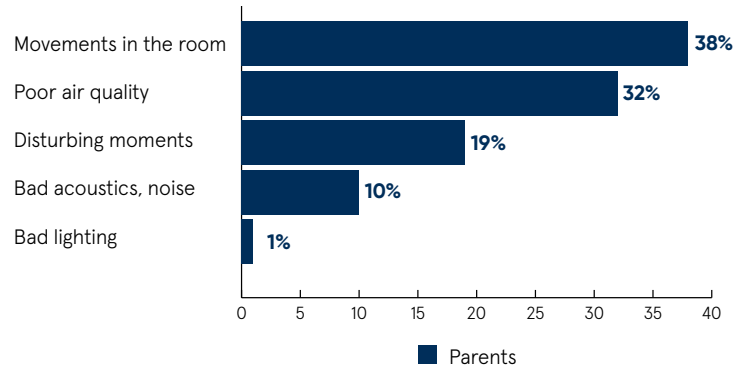
In the survey, when asked about air quality in their children's schools, only one in four parents rates the air quality as Good.

On a scale of 1-10, how would you rate the air quality in the classrooms at your child's school?

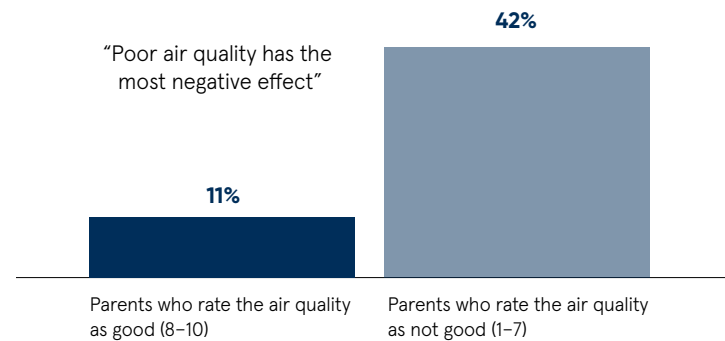


The survey also shows that a third of parents believe poor air quality has a greater negative effect on concentration and learning than overall classroom unruliness.

Which of the following do you think has the most negative effect on students' concentration and learning?



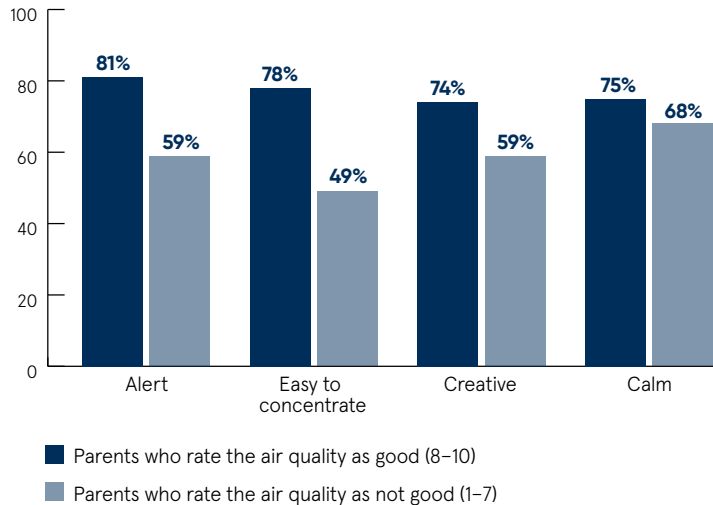
This indicates that air quality is a concern among parents. Looking closer at these answers, one interesting variation emerges:



Out of the parents who believe the air quality in their children's schools to be good, only 11% think poor air quality has the most negative effect on their children's abilities in the classroom. For parents rating the air quality to be low or medium, the same number is 42%.

Concerns regarding the effects and significance of poor air quality in schools seem to go hand in hand with assessments of the air quality in one's children's schools. Furthermore, parents who perceive the air quality in schools to be good are more likely to also rate their children's learning environment positively.

What do you think your child's experience in the classroom is like?



As above graph indicates, parents rating the air quality as good are more likely to also say that their children have a more positive experience of the classroom and a better environment for learning.

(In this graph, it is important to note that the number of respondents is relatively low – only 27 parents in the “good quality” group – meaning these findings should be viewed as indications. Also note that many things can explain this pattern, for instance schools that are better funded may have better teachers and afford better air quality. As such, this does not prove that air quality is the main factor causing the difference.)

Students move around to combat symptoms of poor air quality

Teachers explain that classes are to a greater extent designed to make students move around, to reduce time sitting still. There are generally more activities where students move around in the classroom, for general health benefits and for keeping attention levels up. For instance, there are exercises where students move from station to station in the classroom, and answer different questions at each station.

Malin Valsö points out that there are key benefits of moving around in the classroom. In her 2019 book *Fysisk lärmiljö* (co-authored by Frida Malmgren), she underlines that sitting still for longer periods of time drives fatigue. Moving around and being physically active provides the body with more oxygen, making the brain energized and more capable of concentration. Although being physically active outdoors – in saturated air and daylight – is more efficient, standing up to do occasional physical exercises in the classroom has positive effects on learning capabilities as well.



“With more students in the same space, more oxygen is consumed and more dust is stirred up. When the students move, dust starts flying around and particles are set in motion.”

Malin Valsö, Psychologist

Although there are several benefits, Malin Valsö notes that there is also a notable disadvantage to moving around in the classroom. The capacity of ventilation systems (in classrooms) is often dimensioned for activities where students are relatively still. With more physical activities in the classrooms, ventilation can become unable to work sufficiently.

Another negative effect of more movement in the classroom is that more dust is stirred up and diffused. As dust flies off the floor, there is a greater risk hazardous particles (that the dust might contain) are inhaled. Anna-Sara Claeson also points out that when dust settles on a warm lamp, there might be hazardous emissions as the dust gets heated up.

Students don't just move around in the classroom. Both teachers and students explain that it is accepted for students to take short breaks – officially referred to as bathroom breaks – during classes just to get some fresh air. Although this means students miss parts of the classes, there is an understanding among teachers that these breaks make students more attentive when they are in the classroom. There is a perception that by leaving the smaller and more densely populated classroom, to briefly go out to the loftier hallway, students get a much-needed dose of “high-quality air” to refresh their minds.

Bigger classes, lower ventilation efficiency

Many school buildings are relatively old with a ventilation system generally designed to accommodate the number of students that was standard at the time of construction. Now,

classes are generally growing in terms of number of students per class. Sofia Stenberg, principal at Enskede skola, says:

“Our school has grown from 700 to 940 students since the mid-90s, but the building hasn't been adapted to that growth. Even though there are more people and bigger classes now, there are no signs saying what number of people per classroom the ventilation is optimized for.”

Sofia Stenberg, Principal

With increasingly bigger classes – and more physical activities in the classrooms, as described above – ventilation is often under-dimensioned when it comes to transporting air sufficiently.

Fixed classrooms

There is an ongoing discussion about the pedagogical benefits of fixed classrooms in schools. One notable advantage is they enable students to form a stronger bond to the physical room, allowing them to feel safer and more relaxed during school days. Fixed classrooms eliminate one of many stressors students can experience when moving between rooms.

On the other hand, teachers might be more inclined to ensure good air quality when they stay in the same classroom all day – for instance by opening windows or turning up the ventilation – compared to when they come in to a new classroom for each class.

Built-in barriers for good air quality

As previously mentioned, it is not unusual for schools to be housed in old buildings. Old buildings often provide architectural beauty and cultural value, but at the same time they come with some features that might have negative effects on air quality.

It is pointed out that old buildings often need to be renovated and modified, and that new layers and add-ons can affect air flows in ways that are not always intended or expected.

Also, damages caused by water leakage (due to old pipes), have sometimes been built into old buildings, as they haven't been discovered during renovation. Such damages can lead to mold outbreaks which ultimately has a negative effect on air quality.

“Textiles, wood and other products in indoor environments emit chemical substances. There is awareness of this – we use low-emitting materials and have control over emissions. But we don't have full control over what happens when different materials are combined, and when moisture is added to the mix.”

Anna-Sara Claeson, Docent

It should be noted that it's not only old buildings that might have built-in negative effects on air quality. In contemporary architecture and construction, wooden buildings are



becoming increasingly popular. In regard to sustainability there are several benefits to using wood, and (arguably) it makes for more beautiful and enjoyable buildings. However, wood reacts with other substances and might emit hazardous particles.

“When wood reacts with other materials and substances, there can be emissions causing illnesses. Researchers are investigating this and it’s an ongoing discussion.”

Anna-Sara Claeson, Docent

There are challenges with a high number of old school buildings, but it should be pointed out that many new school buildings are under construction. More modern school buildings, adapted to current needs and standards, are likely to improve the general air quality in Swedish schools.

Indoor air quality can be improved with air purifiers

Although several factors contribute to poor air quality in indoor learning environments, multiple tests (in different countries) have showed that air quality can be significantly improved by air purification. In a test* conducted in a Stockholm school, Blueair technicians ascertain that just one hour of air purification can reduce the number of hazardous particles in a classroom by up to 92%. In tests where air purifiers were used for two hours (in classrooms at the same school), results indicate an even greater

improvement. These results are for instance consistent with results from a 2018 test conducted in a London primary school, which showed a 96% reduction of particles (particles ranging from 2.5 µg to 10 µg).

* The test was conducted in February 2021, in three different classrooms in a school in Enskede, Stockholm, Sweden. Samples were made before, and then after, a Blueair Classic 680i air purifier was activated (filtering out fine particles, 2.5 µg).

Health effects of poor air quality are underestimated

Easier to see short-term health effects than more serious long-term ones

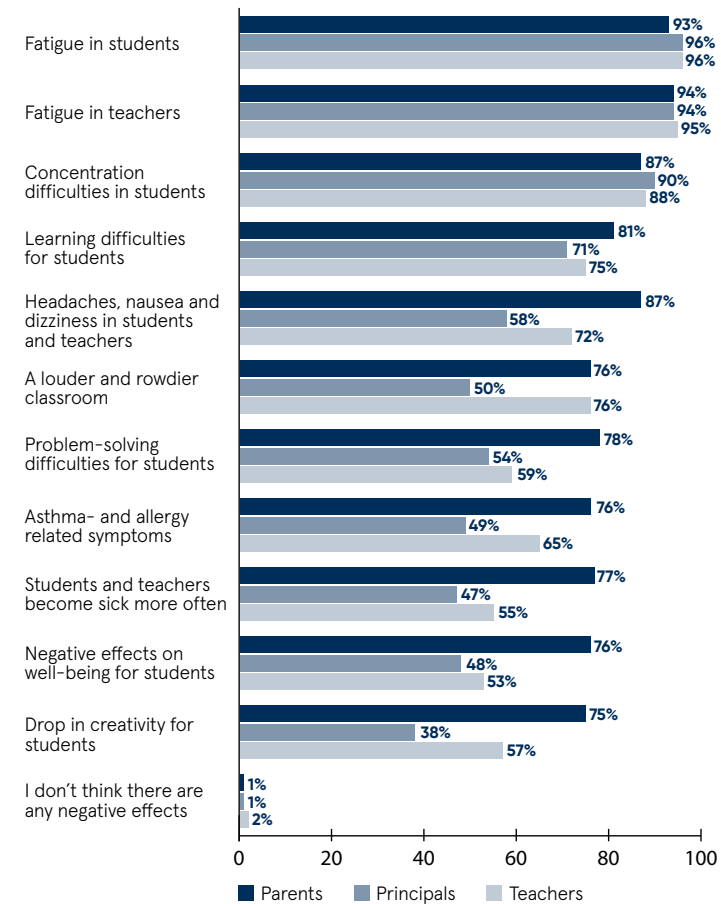
This study clearly shows that there is an overall understanding among teachers, school principals, students and parents that poor air quality has negative effects on health, cognitive abilities and general well-being. However, the impact of these effects is generally underestimated. As will be elaborated on below, poor air quality is primarily associated with short-term symptoms, rather than with long-term consequences.

The awareness of short-term health effects is high

There is a clear understanding that poor air quality in schools can cause health issues. As the figure below shows, issues associated with poor air quality are primarily temporary and “superficial”, in the sense that they mainly are evident in the present. This means respondents tend to think people may experience health issues while being exposed to poor quality air, but that the issues subside or vanish once the exposure ends – for instance after leaving the room or open a window.

Parents, in comparison to principals and teachers, are more likely to think poor air quality has negative short-term effects on students: decreased abilities to learn and solve problems; reduced creativity; and a lowered sense of well-

How do you think poor air quality and pollution affects a school environment in the short-term?



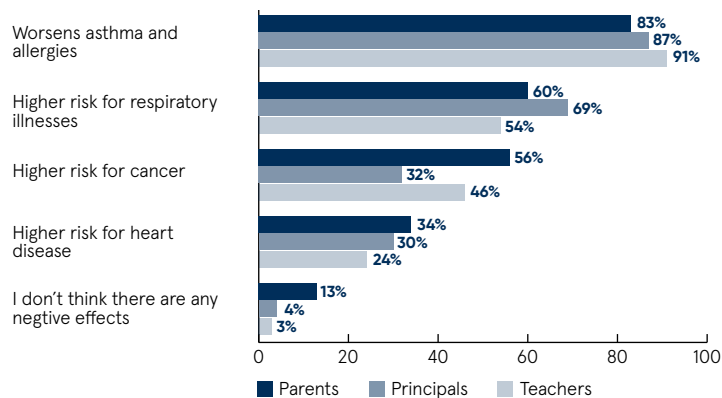
being. Furthermore, parents are more likely to think students experience headaches, nausea, dizziness – as well as asthma and allergies – as a consequence of poor air quality and air pollution.

This might be an effect of children being more transparent about their experiences with their parents than with school staff. It might also be related to parents being worried about and protective of their children, meaning they are more likely to see potential threats to their children’s well-being.

Lower awareness of long-term consequences

While the awareness of short-term effects proves to be high, respondents are less likely to attribute more serious long-term consequences to poor air quality.

How do you think poor air quality and pollution affects the health of students and teachers in the long term?



While a relatively high number of respondents associate poor air quality with asthma and allergies (87% on average), not nearly as many believe it increases the risk for (other) respiratory diseases (61% on average), cancer (45% on average), or cardio-vascular diseases (29% on average).

That poor air quality is more strongly associated with asthma and allergies, compared to more serious diseases, can be a consequence of air quality primarily being connected to fresh and crisp air.

Actual health effects are underestimated

According to experts, poor air quality and air pollution pose several threats – some of which are far more serious than the rather “superficial” and temporary health issues many respondents think of.

“Air quality has significant effects on health and learning, both short-term and long-term.”

Malin Valsö, Psychologist

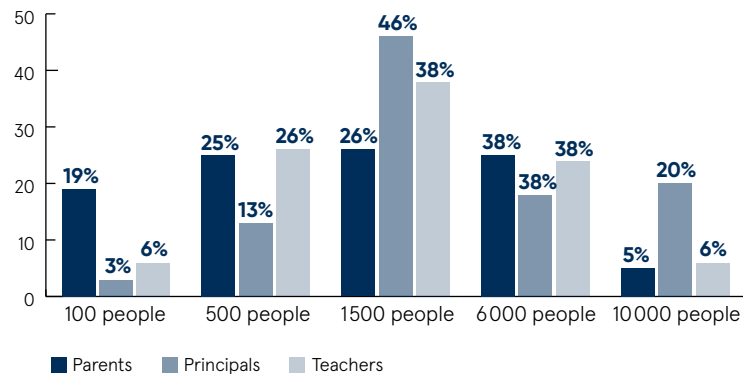
In the most alarming cases, air pollution can lead to serious diseases such as:

- Chronic obstructive pulmonary disease (COPD)
- Pulmonary cancer
- Cardio-vascular diseases
- Nervous system diseases

According to a 2018 study from Umeå University and the Swedish Environmental Research Institute (IVL), almost 8 000 premature deaths in Sweden are due to air pollution (annually). A German study, published 2019 in European Heart Journal, claims that number is higher than 8 000.

When asked about the fatality of air pollution, a clear majority of respondents significantly underestimate its severity.

Approximately how many deaths are caused by air pollution each year in Sweden?



A third of the respondents are remarkably off in their estimate; the actual fatality rate is more than 10 times higher than they think. Another third of respondents are quite mistaken as well, the actual fatality rate is more than 5 times higher than they think.

Interestingly, more than half of Swedish principals – people with responsibility over the health of students and school staff – significantly underestimate how many people die from air pollution.

Short-term problems can easily become long-term

Although some effects might seem short-term, experts point out how they can cause ripple effects and cognitive scars that can linger for the rest of their lives. When poor air quality causes allergies, asthma or other respiratory issues, there is a risk that cognitive capabilities are reduced. For instance, research indicate that spending just a short time (ca 25 minutes) in an environment with high levels of carbon dioxide and low levels of oxygen lowers abilities such as:

- Problem solving
- Math proficiency
- Ability to concentrate

Short-term, this means that students’ abilities to learn decrease after the first half of a standard-length class. Long-term, this means that students might under-perform in early grades, which subsequently (involuntarily and unconsciously) can limit their options for higher education and future professional opportunities.

Furthermore, chemical substances can cause sensory irritation that eventually become chronic, meaning symptoms won’t disappear upon leaving the room and getting “new” air.

“You would think this irritation only appears when you are in a room with poor air quality. But it seems if you spend enough time in the room, such irritation can become chronic. Which means you will not feel better even if you leave the room.”

Anna-Sara Claeson, Docent

There are cases where air pollution has caused hypersensitivity, which can disable one from spending time in public spaces such as theaters, restaurants, and offices. Being unable to take part in common social activities in shared environments can, in turn, lead to long periods of sick leave and depression.

“Long-term exposure to poor air quality in lower school levels can contribute to students not reaching educational goals necessary for high school qualification. Students not reaching educational goals has an increased risk of developing mental health problems, criminal behavior, drug abuse and social exclusion.”

Malin Valsö, Psychologist

Some indirect long-term risks of not being able to manage school due to issues caused by air pollution can be:

- Long-term unemployment
- Criminal behavior
- Mental health problems
- Social exclusion

Malin Valsö points out that all these consequences come with enormous costs – both for the individual and for society. On an individual level, anyone suffering from only one of the above challenges would experience great personal hardship. On a societal level, the above problems render governments significant costs in the form of financial support (social benefits), tax revenue loss, healthcare, law enforcement, etc.

The main threat is fine particles

Fine particles are potentially more harmful than coarse particles as they are able to travel deeper into the lungs and, in some cases, even out in the bloodstream. Coarse particles are less likely to be harmful as they, to a greater extent, are caught in the upper airways.

In the context of learning environments, it is important to stress that air pollution is more threatening to young people, such as elementary and secondary school students. They have higher metabolism and breathe more intensely, thus, they inhale more of the hazardous particles.

“Medically speaking, poor air quality is a problem. It’s primarily the fine particles that are dangerous, as they get deep into the lungs and out the bloodstream. They can cause inflammatory responses which can lead to disease.”

Katarina Gospic, M.D. and Ph.D.

As pointed out in an earlier chapter, clean air is generally associated with outdoors air. Although outdoor air is not necessarily cleaner than indoor air, there is some support for the assumption. According to an EPA (United States Environment Protection Agency) study, the amount of particles indoors can be up to 5 times the amount outdoors. This means that the risk of illness caused by hazardous particles is greater indoors. When it comes to learning environments, this risk is further increased by the fact that ventilation in many school buildings is often insufficient (as described in previous chapter).



“We spend 90 percent of our time indoors, yet we spend almost all of our time thinking about outdoor air pollution.”

Joseph Allen

Awareness of indoor air quality is relatively low

There is a blindness to indoor air pollution

Although there is relatively high awareness when it comes to poor air quality outdoors, the awareness of indoor air pollution is significantly lower. This becomes evident, for instance when talking to students, teachers and principals:

“I don’t even know if it’s called ‘air pollution’ when it’s indoor air we’re talking about?”

Teacher

Joseph Allen is an Assistant Professor at Harvard’s T.H. Chan School of Public Health. In a 2017 Harvard Business Review article discussing air quality in indoor environments in general, he shows that this skew perception is not limited to learning environments:

“We spend 90 percent of our time indoors, yet we spend almost all of our time thinking about outdoor air pollution.”

Joseph Allen

In Sweden, regulation is often imposed or strengthened when it comes to outdoor air pollution. For instance, when we learn how studded tires stir up hazardous particles, we ban use of such tires on (selected) inner-city streets. When we learn about how burning garbage discharges heavy metals,

we invoke restrictions on waste incineration. However, similar regulation concerning particles in indoor environments – including schools – are relatively sparse.

According to Katarina Gospic, the reason for this might be related to a (generally) limited knowledge about the physiological effects of air pollution, and the fact that our awareness of health hazards is influenced by the public discourse. As an example of the latter, she points out that most people (in Sweden) are well aware of the fact that smoking can cause pulmonary cancer, as this has been publicly discussed for a long time. Since indoor air pollution hasn’t been a widely discussed topic, relatively few are familiar with the facts of the matter.

Consequently, there is a potential to raise the general public’s awareness of indoor air pollution and the various effects it has – by initiating and facilitating a public discussion.

Indoor air quality is thought to be a matter of ventilation

In general, indoor air quality is strongly associated with oxygen levels and air flows – fresh air and sufficient ventilation is top-of-mind. Few respondents spontaneously think of hazardous particles and actual purifying of the air.

When teachers and students experience poor air quality, they explain that they open the windows to let fresh air in. According to their perception, this improves the air quality (if yet temporarily).

It should be noted that proper ventilation has positive effects on air quality, and that ventilation is a major issue in Swedish schools (according to a 2016 study conducted by Swedish Work Environment Agency). Furthermore, ventilation can have some impact on particle levels in a classroom.

However, in discussing clean air with respondents, the focus on ventilation is clearly disproportionately high.

Important to raise awareness about indoor air quality

“We care so much about the food we consume, but it seems we don’t care very much about the air we breathe.”

Katarina Gospic, M.D. and Ph.D.

The experts in this study all underline that the awareness of – and general knowledge about – indoor air quality needs to be increased.

Not only that – given the serious nature of this issue and the critical consequences treating this topic carelessly will have, they also find it somewhat surprising that these issues are

not more top-of-mind. Usually, when issues concern our children’s health, they are tended to with high priority. To be clear, that children are more sensitive to air pollution is a well-established fact and not a controversial stance. There is a general consensus that the health and cognitive capabilities of our children is a serious matter and that any threat needs to be instantly addressed.

“In general, children are more sensitive since they aren’t fully developed. They lack the resilience adults have.”

Katarina Gospic, M.D. and Ph.D.

The reasons behind the limited awareness and knowledge of negative health effects of air pollution remain unclear. Katarina Gospic notes that there might be a – in a sense – positive reason (or contributing factor): we haven’t had to concern ourselves too much with air pollution in schools in Sweden in recent times because it has not been a major problem compared with other countries, and that many of us live in places with good air quality.

A 2014-15 study conducted by the Swedish Public Health Agency (Folkhälsomyndigheten) might support this hypothesis: an assessment of the general air quality in Swedish schools shows that 85% of schools rate Good or Quite good.

Air quality – regulation and responsibility

Overestimation of air quality regulation

Teachers and principals have some awareness of air quality-related regulation. Top-of-mind is a mandatory ventilation check that is recurrently carried out in most types of buildings, in Swedish referred to as OVK (obligatorisk ventilationskontroll).

“A problem with OVK is that it only looks at the flows of air in and out of the room, but it doesn’t measure the occurrence of chemical substances.”

Anna-Sara Claeson, Docent

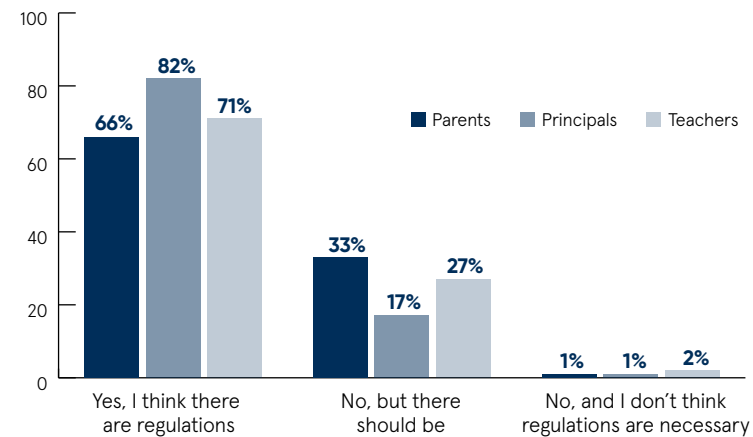
As Anna-Sara Claeson points out, OVK checks regard air flow but not chemical substances and particles that can cause sensory irritation, even though such sensory irritation can lead to chronic diseases (as has been previously described). Katarina Gospic finds it remarkable that regulation of indoor air quality in Sweden only applies to ventilation, not the presence of harmful particles or chemical substances. She believes that there is a gap in the well-regulated Sweden as air pollution, in addition to the fact that in the short term it could worsen the conditions for learning and teaching, also can contribute to illness in the long term.

The general knowledge about regulation concerning potentially hazardous substances and particles is significantly

lower (or non-existent). Interestingly, Sweden seems to be remarkably un-regulated in this area. Sweden is often characterized as a society with an ample amount of regulation in most areas – especially when it concerns the general public’s health. In general, accepting and adhering to government regulation is often said to be imbedded in our culture.

When asking parents, teachers and principals about air pollution regulation, a majority falsely believes air pollution in schools is more well-regulated than it is.

Do you think there are any regulation regarding air pollution in Swedish schools?



While there is regulation in regard to ventilation and air flow, such as the above mentioned OVK, there is a notable lack of regulation specifically about particles and indoor air pollution. As has been noted above, some find it somewhat surprising that a well-regulated nation like Sweden has such a limited regulation of air quality.

There is a notable willingness to improve indoor air quality

In schools, issues related to poor air quality are prioritized and principals express a high willingness to act on these problems to improve the environment for students and staff.

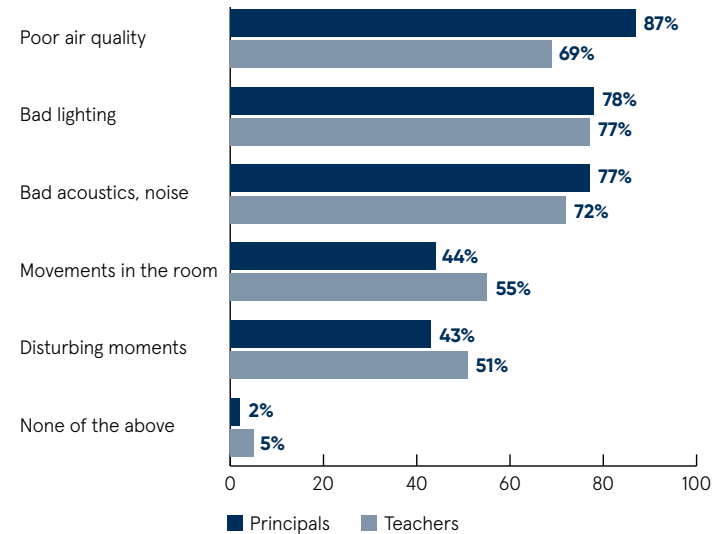
“It’s very important to us to improve air quality, and to do that here we need to do something about the ventilation.”

Sofia Stenberg, Principal

Four out of five principals and teachers in the survey say they have worked actively to improve the air quality in their schools. Out of a set of typical problems in classrooms, air quality is the factor most principals claim to have worked actively with to improve.

When principals elaborate on the measures taken, most regard ventilation. It should be noted that some even

Have there been any initiatives at your school to make improvements on any of the following?



consider opening the windows to let outside air in an initiative to improve poor air quality. Some say they have installed new air purifying filters.

Although improvements primarily regard ventilation, they reveal a willingness to actively work on the overall air quality in their schools.

Willingness to improve indoor air quality can be increased

Arguably, the willingness to improve indoor air quality can be further strengthened. By showing actual benefits, school leaders are (presumably) incentivized to direct more attention to the matter.

In their 2015 report *Clever Classrooms*, a group of University of Salford researchers point out that poor air quality is a relatively common problem in (British) classrooms – and that good air quality has a significant impact on the learning environment.

There is also evidence that good air quality is beneficial for cognitive capabilities in general (not only for students in learning situations). Joseph Allen, Assistant Professor at Harvard's T.H. Chan School of Public Health, says in a 2017 *Harvard Business Review* article that working in an office with higher air quality and better ventilation has significant positive effects on the staff (knowledge workers); key benefits are better decision-making performance and higher test scores across nine cognitive function domains.

He estimates, based on his research, that an annual USD 10-40 per-employee investment in air quality and ventilation increases the productivity of each employee by several thousand US dollars per year. This does not include the associated benefits of fewer people being absent and/or suffering from “sick building” symptoms such as headaches and fatigue.



Key challenges to ensuring good indoor air quality

When it comes to ensuring good air quality in Swedish schools, some key challenges emerge. Overall, they can be divided into four main categories:

Low understanding of the problem

- The notion of air quality is still largely seen as a matter of ventilation and air flow, not something that includes the actual composition of particles.
- The problems and physiological symptoms caused by poor air quality are not always clear and obvious; on the contrary they can be vague and difficult to attribute to air quality specifically. As for the physiological symptoms, there is a stigma attached to talking to your colleagues and principals about personal health issues that might be difficult to explain/attribute to a certain cause – as there is a risk of being seen as over-sensitive or a hypochondriac.

Responsibility is redirected

- Often Swedish school buildings (the real estate) are owned and managed by other organizations than those operating the school (providing the actual function of education). In some cases, even when principals actively want to improve indoor air quality they are unable since the responsibility for real estate development and maintenance falls under another organization. Getting

property managers to prioritize air quality is said to be challenging, as they compare the consequences of poor air quality with the costs for additional development and construction.

- Teachers point to a “chain-of-command” only allowing them to report things to principals and hope the issue trickles up to someone who can implement a solution.
- Some mention that the property managers in charge of the school buildings they work in are big corporations with lots of real estate to manage, meaning changes take a long time as there is much bureaucracy (and responsibility risk falling between the many cracks in the organization).

Passiveness

- Some are reluctant to cause any problems in the workplace, meaning they go to great lengths to avoid complaining although they experience situations or symptoms that should prompt complaints.
- Some feel they don't know how to address issues pertaining to poor air quality.

Financial restraints

- Some say there are financial barriers to improving air quality.

Raising awareness of air quality: Reflections

To increase awareness of indoor air quality in learning environments and to contribute to improving air quality in Swedish schools, these strategies are suggested:

Expand the notion of air quality

- Strive to raise awareness of air quality, and increase the knowledge about what it actually entails.
- Suggest expanding mandatory ventilation checks (OVK), so that they include detecting hazardous particles and chemical substances.
- Establish more extensive and clear guidelines and regulations regarding air pollution.

Help teachers identify the problem

- Educate teachers about air quality, and clarify what symptoms poor air quality might have.
- Suggest methods or systems allowing teachers to report air quality-related problems or symptoms to those responsible for solving them (instead of to the “middle men” – the principals).

Help principals escalate the problem

- Educate principals about air quality, and clarify what symptoms poor air quality might have.
- Suggest methods for continuous tracking of air quality.

- Suggest methods or systems allowing principals to report air quality-related problems or symptoms to those responsible for solving them.

In addition to the above there is a great value in addressing local politicians and municipality staff to make sure they realize what is at stake if they don't pay enough attention to the issue of indoor air quality. Malin Valsö summarizes this particular point well:

“To ensure good opportunities for our children to be successful in life, it is essential that we invest in creating good environments for long-term learning. Good air quality is a pre-requisite for a healthy learning environment. The investments we do now, in regard to ensuring good air quality, we will reap the benefits of in the future.”

Malin Valsö, Psychologist

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IMAGES

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