



Development of novel assessments for indoor air quality monitoring and impact on children's health

D8.5 Public participation: Integration of results in decision processes

LEARN

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4	Katholieke Universiteit Leuven (KUL)	BE
5	Universiteit Hasselt (UH)	BE
6	Mann+Hummel GMBH (M&H)	DE
7	Nanotechnology Industries Association (NIA)	BE
8	Stichting IMEC Nederland (IMEC-NL)	NL
9	Aarhus Universitet (AU)	DK
10	F. Iniciativas España Mas i Mas SLU (FI)	ES
11	AlveoliX (AL)	CH

Project aim

LEARNIng about the status of air quality in schools and its impact on the cognition of children is a major cornerstone in LEARN. For that, we want to overcome the barriers of the currently existing technologies and take a bold step towards developing and deploying novel sensors to detect the presence of possibly harmful air pollutants such as volatile organic compounds and ultrafine particles.

We will measure and characterize indoor and outdoor air pollutants and evaluate the presence of biomarkers of exposure and their effect on children's cognition while trying to recapitulate those effects using *C.elegans* as a biosensor. Moreover, we will use



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advanced human-based in vitro models of lung and skin coupled with a revolutionary multi-sensing device to investigate their mechanisms of toxicity in real time.

Novel remediation strategies will be explored to improve air quality and promote children's quality of life and life expectancy. For that, we will mobilize a group of eleven leading research teams, unrivalled in their respective fields (environmental epidemiologists, toxicologists, air quality specialists, systems biology, engineers, and citizen/social scientists).

The scientific achievements expected to result from LEARN will unlock a large technology potential in IAQ for decades to come, leading to disruptive societal and economic impacts steaming from a radical improvement in the quality of life of children in Europe.

Project LEARN is part of the European indoor air quality and health cluster.

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Executive summary

This deliverable is part of Work Package 8 'Exploitation, Communication and Dissemination', Task 8.2 'Development of participatory policy making processes'. The aim of this task is to set up participatory processes with diverse stakeholders around indoor air quality (IAQ) guidelines and management plans. Through these processes, we aim for fair treatment, meaningful involvement and social inclusion in decision making processes around IAQ.

The first deliverable of this task outlined the methodology for participatory policy making, i.e. the PAR4-P methodology, and its first results. The methodology consists of five different phases: (1) problem definition, (2) stakeholder mapping, (3) participatory action I, (4) participatory action II and (5) formulating guidelines. The results of phases 1 and 2 were reported in deliverable 8.2, and the results of phases 3, 4 and 5 are reported in this deliverable.

For **phase 3 'Participatory action I'**, **11 in-depth interviews with 13 experts** were organised in Belgium, Denmark and Greece. These experts were identified during phase 2 'Stakeholder mapping'. The purpose of these interviews was to collect information about current good practices related to IAQ management, and to what extent these address the specific needs of vulnerable groups. Furthermore, the experts reflected on how current policy guidelines or frameworks could be improved. The results of this phase are reported in Chapter 3 through two schematic figures of challenges and solutions of IAQ management in school environments.

For **phase 4 'Participatory action II'**, the initial idea was to organise participatory workshops in the participating schools of the cohorts to ask parents about IAQ management in school environments. However, given the difficulty in recruiting sufficient participants, the workshops were replaced with a **large-scale survey** for parents, children and other stakeholders at schools (headteacher, teacher, technical and supporting staff). In total, 317 participants completed the survey. In addition, an online social media campaign was launched to help prioritizing policy solutions based on the pre-identified findings of the interviews. The results of participatory action II are reported in Chapter 4.

Finally, for **phase 5 'Formulating guidelines'**, the results of the previous phases were triangulated and summarized into specific guidelines for the improvement of IAQ management in school environments. The outcome of this phase will further serve as inputs for task 8.4 "Policy recommendations for IAQ monitoring and standards", led by NIA. A list of guidelines is reported in Chapter 5.



1. Introduction

The approach taken in Task 8.2 is to organise collaborative processes among school building occupants and users about the causes and effects of indoor air pollution as well as its mitigation strategies. Therefore, school stakeholders are invited in participatory policy making processes for healthy indoor school environments. In specific, through the PAR4-P method, we involve diverse stakeholders, including school staff, pupils, parents, and health and environmental experts. Each of these groups brings distinct knowledge, experiences, and responsibilities, and their input is essential to ensure that guidelines are not only scientifically sound, but also understandable and relevant in everyday school practice. Involving multiple diverse stakeholders also helps to build ownership, legitimacy and support for implementation.

This report therefore starts from the premise that IAQ management should be approached as a shared responsibility. By bringing together different perspectives, new guidelines can better reflect the realities of school environments, address practical constraints, and support inclusive and workable solutions. In a context where the urgency of healthy indoor air is widely acknowledged, but where implementation often remains fragmented, participatory guideline development offers an important way forward.

This report provides an overview of the current situation and related concerns and problems concerning IAQ management in Belgium, Greece and Denmark. Where possible, country-specific comparisons are included. Based on triangulated results, we provide a set of practical guidelines to inform a specific set of policy recommendations for the LEARN project.



2. Methodology: Participatory Action Research for Policy Development

This chapter outlines the methodological framework for Task 8.2, which was implemented and reported throughout this and the previous deliverable 8.2 (M16).

We applied the methodology of **Participatory Action Research for Policy Development**, or short the **PAR4P-method**. We define PAR4P as the inclusion of citizens and/or organisations in a participatory approach for (re)-defining problems and formulating solutions with an eye on achieving more sustainable policy making. The added 'P' expresses thus the explicit intent to conduct research for actions related to policy development, such as informing and influencing policy makers, formulating policy recommendations, wide dissemination of policy guidelines, etc. This methodology is developed by the VUB, research group SMIT, and is being used in various policy domains, such as in media and communication, mobility, urban greening, digital policies, etc. (cfr. Laenens et al., 2019; Van Leeuwen et al., 2022).

The PAR4P-method is a mixed-method approach, with specific methods such as stakeholder consultations, interviews, policy analysis, brown paper method, focus groups, etc. Through collaborative learning and action, PAR4P aims to deepen participation in policy development and, if participants desire, take specific actions towards policy change.

The overall methodological framework was operationalized by VUB and implemented in the countries of the cohort studies. Therefore, VUB provided specific support to the local partners in Belgium (UHASSELT), Denmark (Arhus University) and Greece (Envirometrics).

The PAR4P-method was implemented through five phases (See Figure 1):

- (1) **Phase I - Problem definition:** In this phase, the issue of investigation was identified and defined in D8.2 through a literature and policy review. We looked at the scope and causes of the problem, and who experiences the problem.
- (2) **Phase II – Stakeholder mapping:** In this phase, the stakeholder groups affected by the issue were identified and listed in D8.2.
- (3) **Phase III - Participatory action I:** In this phase, the participants identified in phase 2 were invited for the first participatory action, namely an in-depth interview with policy makers and experts in the field of indoor air quality management. In total, **11 interviews** were organised, 6 in Belgium, 3 in Greece and 2 in Denmark (13 persons in total). The interviews explored the extent of the problem of IAQ in school environments, and its potential consequences. The interviewees were also invited to reflect on potential solutions. The outcome of this phase is reported in this deliverable in **Chapter 3**.
- (4) **Phase IV - Participatory action II:** In this phase, the second participatory action took place, namely a large-scale survey. The survey primarily targeted parents, children (9-12 years old), and school staff. The survey explored desirable and achievable solutions for solving IAQ management in schools. A marketing agency helped to recruit participants in Belgium, Greece and Denmark. The outcome of this phase is reported in this deliverable in **Chapter 4**.



- (5) **Phase V - Solution formulation:** In the final phase, the formulated solutions are listed, and concrete scenarios are drafted based on inputs gathered from phase 3 and 4. The outcome of this phase is reported in **Chapter 5** and will further serve as inputs for Task 8.4 “Policy recommendations for IAQ monitoring and standards”.

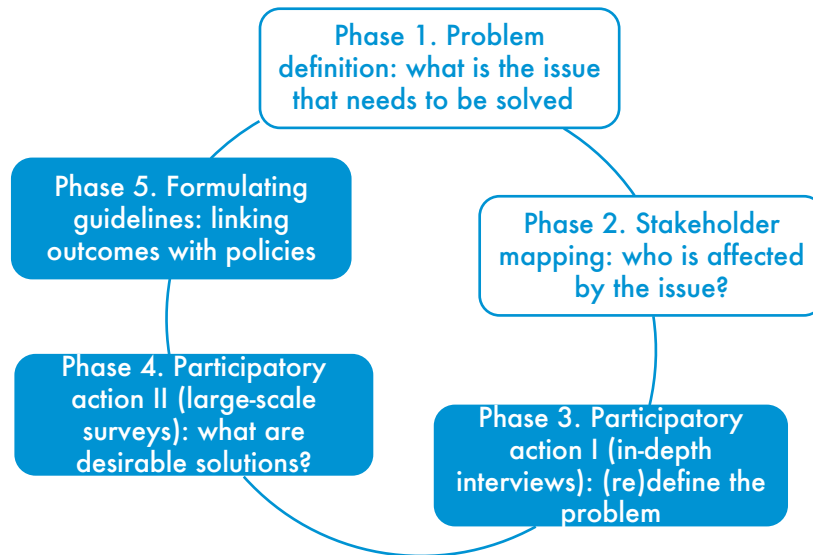


Figure 1: PAR4P-method: Phases 1 and 2 were reported in deliverable 8.2, phases 3-5 are reported in this deliverable 8.5.

The following paragraphs explain the methodological set-up of each phase in more detail, with also a short recap of the activities for phase 1 and 2.

2.1. Phase I – Problem definition

For the situational assessment, i.e. the definition of the problem, a quick scan analysis of existing policy documents on indoor and outdoor air quality was performed. In D8.2, these documents were analysed through the methods of ‘**quick scanning**’ and ‘**close reading**’. The quick scan analysis is a fast and systematic way of identifying a set of relevant elements within a large body of text (Lordache et al., 2017), while the method of close reading is useful for capturing underlying meanings (Schur, 1998).

More specifically, the analysis of the documents focused on:

- An analysis from social sciences perspective: awareness raising, and communication guidelines were retrieved.
- Gaining better insights into the objectives of these documents, and specifically the directives and guidelines for school environments and vulnerable groups, such as youth. As such, the scoping review is **not** focussing on technical descriptions of the methodologies, but rather on **how the different directives and guidelines are paying attention to the inclusion of vulnerable groups, specifically children, in a school setting.**
- Assess if current policies are sufficiently feasible and innovative to deal with current IAQ challenges in school environments.



- Compare the air quality directives and guidelines across the three cohort countries and assess the situation to identify opportunities for improvement for healthy school environments.

The results of this phase are reported in D8.2, although new relevant documents were identified during the in-depth interviews. These additional updates are reported in Annex V - Updates Phase 1 of this deliverable. These additional documents do not affect the conclusions from D8.2; rather, they reaffirm that Belgium is making good progress in terms of both federal and Flemish laws on indoor air quality (IAQ) management. Furthermore, IAQ guidelines cover a variety of areas, including building construction, energy performance, and heating and ventilation, thus demonstrating the diverse range of governing responsibilities. If there is no specific IAQ decree, these can be found in other guidelines (e.g. energy performance or healthy indoor work environments), as is the case in Denmark and Greece.

2.2. Phase II - Stakeholder mapping

For the stakeholder mapping, the lead of each cohort study was requested to identify stakeholders who have an interest in policy-making processes around indoor air quality for school environments.

Stakeholders could be identified in the following categories:

- **Societal stakeholders:** For instance, a representative of a parent committee, a community-based organisation working in the domain of indoor health, a neighbourhood association working on the topic of climate change, individuals such as parents and school children, interested neighbours, etc.
- **Academia:** For instance, university-based researchers in disciplines such as health, bioengineering, etc.
- **Public sector:** For instance, local policy makers in the domain of health, environment, mobility, urban planning, etc., working groups on indoor air quality.
- **Private sector:** For instance, facility managers of the school, designers and architects, ventilation specialists, etc. (which might also be regarded as 'public', if working in consultation for a public school).

The stakeholders of the public sector and other relevant expert domains who eventually took part in the interviews are listed in Chapter 3.

2.3. Phase III - Participatory action I

During the first participatory action, in-depth interviews were organised with policy makers and experts in the field of IAQ management. In total, 11 interviews were organised, 6 in Belgium, 3 in Greece and 2 in Denmark (13 persons in total, See Chapter 3). Each interview lasted approximately 1 hour to 1 hour 30 minutes. The interview consisted of the following parts: (i) short presentation of the LEARN project, (ii) oral consent to participate in the in-depth interview and to use their answers for scientific purposes, (iii) questions on the background and profile of the participants, (iv) questions about current policies and guidelines on indoor air quality, (v) questions about environmental justice, (vi) questions related to guidelines and interventions for school environments. If possible, the interviews



were audio recorded, then transcribed and coded with the help of the software tool 'MAXQDA'. After transcription and coding the original audio files were deleted. The main codes that were used during the analysis were the following: current guidelines, economic challenges, environmental equity, topical affairs, concerns, education and awareness, expertise, environment-related factors (location and constructions factors).

The full topic list of questions is included in Annex I – Interview with policy makers & experts (phase III).

2.4. Phase IV - Participatory action II

During phase 4 of the PAR4P-method, workshops were planned for each pilot country. In total, two interactive workshops would have taken place per cohort location, with a minimum of six to a maximum of ten participants in each workshop. During the workshop, gaps, opportunities, and challenges related to IAQ management in school environments would have been discussed with parents. However, due to a low turn-up rate of three initially promoted workshops, it was decided to cancel the remaining workshops and replace them with a large-scale survey. This decision was taken in agreement with the local school stakeholders, who expressed that it is rather difficult for parents to join after-school activities and to streamline communication with external organisers. In case someone would be interested to organise a collaborative workshop around this topic with school stakeholders, they can use the prepared LEARN materials for this activity (See Annex II - Workshop Script).

In replacement of the workshops, a large-scale **survey** was developed and promoted with the help of a marketing agency to recruit parents (with children between 9 and 12 years old). With their help, 300 participants were recruited (100 per pilot country). In addition, the survey was launched through the LEARN network and the IDEAL cluster, resulting in an additional 34 responses. The period of data collection occurred for almost one month, between 06/02/2026 and 10/03/2026. After data cleaning (removing invalid responses, checking the average time of completion, coding missing values with '99', searching for cases with straight lining behaviour), 317 responses remained valid. The analysis of the merged survey results occurred by the software tool 'SPSS'.

Most participants (85%) completed the survey in ten minutes, and the survey was available in English, Dutch, Danish and Greek. The survey consisted of the following sections: (1) welcome section with introduction about the LEARN project, (2) informed consent, (3) entry and screening questions, (4) awareness and knowledge questions about indoor air quality in school environments, (5) background information about guidelines and legislation around indoor air quality management in Europe (6) ranking of five dilemmas, (7) prioritization of solutions, (8) questions for children to complete with their parents, and (9) questions specifically for school professionals. The most important questions were the ranking of five dilemmas (part 6 of the survey), which were drafted based on the inputs of the in-depth interviews with policy makers (See phase III – PAR4P). For five dilemmas, participants could choose between two options and provide a reasoning for their arguments.

Not all sections had to be completed by all participants. The marketing agency specifically focussed on the recruitment of parents in Belgium, Greece and Denmark (with children between 9 and 12 years old), participants who did not meet these criteria could not complete the survey. However, the survey distributed in the LEARN and IDEAL cluster network was open to all. In addition, a **social media campaign** was launched on the LinkedIn page of the LEARN project. Here, three different dilemmas were again presented to the audience, whereby the posts had the aim to spark debate online.

No personal identifiable information, such as names or email addresses, were recorded in the survey. A specific section of questions was directed at children who completed those questions together with their parents. Specific consent was asked from the parents before proceeding with the set of questions for their child. The children were asked to provide their age (as a means of verification), share a satisfaction score for the IAQ in their school, assess the extent to which IAQ affects how they feel or learn, assess whether their teacher is helping with keeping the air clean in the classroom, whether they would like to learn more about healthy indoor air, whether they alert the teacher if the air in the room is bad and if they would like to help their teachers with keeping the air fresh in the classroom.

The survey template can be found in Annex III, as well as the informed consent template in Annex IV. Ethical approval was granted by the Ethics Commission in Human sciences by the Vrije Universiteit Brussel for this research task (reference number: ECHW_411-WP8_8.2-7.3).

2.5. Phase V - Formulating guidelines

Based on the outcomes of participatory action I and II, guidelines are formulated to improve IAQ management in school environments. The guidelines represent recommendations for further amelioration of healthy indoor air, based on a combination of expert opinions and factual figures. These outcomes are shared with T8.2 (led by NIA), that will use these inputs for drafting the LEARN policy recommendations and disseminating them to a wider audience.

3. Participatory action I: Interview results

A total of **11 interviews** were conducted with 13 experts and policymakers working in the fields of environment, health and urban design across Belgium, Greece, and Denmark. The aim was to evaluate the current state of IAQ management in schools and to explore opportunities for improvement.

The table below lists the policy makers and experts who were interviewed in the three pilot countries. Overall, 11 interviews were organised with 13 participants, 6 interviews in Belgium, 3 in Greece and 2 in Denmark. Most interviewed participants were from the public sector (from different domains, either health, environment or safety), and from the private sector. The contact details of the interviewees were removed for the analysis, and each interviewee received a reference number for explaining the results in Chapter 3.1

Table 1: Interviewed stakeholders – Belgium, Denmark and Greece.

Organisation	Category	Domain	Reference number
BELGIUM			
<u>Flanders Environment Agency</u> (Vlaamse Milieumaatschappij)	Public	Environment	Interviewee B1
<u>FOD Volksgezondheid</u> , Platform binnenluchtkwaliteit (federal governmental level)	Public	Health & Environment	Interviewee B2
<u>'Departement Zorg'</u> / Department of Care (Flemish governmental level)	Public	Health	Interviewees B3 (2 persons)
<u>Vlaams Instituut Gezond Leven</u>	Private / expertise centre	Health at school, nurseries and elderly care facilities	Interviewee B4
<u>MOS scholen</u>	Academia / public and private	Sustainability at school	Interviewees B5 (2 persons)
<u>Departement Omgeving</u> (The Department of Environment and Spatial Development) (Flemish governmental level)	Public	Environment	Interviewee B6
DENMARK			
Det Nationale Forskningscenter for Arbejdsmiljø/ <u>The National Research Centre for the Working Environment</u>	Public	Occupational health and safety	Interviewee D1



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Det Nationale Forskningscenter for Arbejdsmiljø/ <u>The National Research Centre for the Working Environment</u>	Public	Occupational health and safety	Interviewee D2
GREECE			
<u>Design Clips</u>	Private	Urban Design & Architecture	Interviewee G1
<u>Environmental Centre of Western Macedonia</u>	Public	Environment	Interviewee G2
Environmental Department of Municipality of Thessaloniki	Public	Environment & Air Quality	Interviewee G3

3.1. Status of IAQ management in Belgium, Greece and Denmark

The interview results suggest that despite growing awareness of IAQ-related issues – especially since the Covid-19 pandemic – IAQ management remains under-prioritised in many policy agendas.

Most experts indicate having limited expertise or practical experience with IAQ management specifically, underscoring the greater attention paid to outdoor air quality. Instead, they draw on their expertise related to outdoor air quality to offer IAQ monitoring and policy advice, acknowledging that indoor and outdoor air are intricately linked. Two Belgian experts also reflect on their experiences in different settings, such as nurseries and elderly care facilities. Similarly, two Danish interviewees rely on their expertise in studying and monitoring occupational environments, including indoor environments.

In **Belgium**, the ‘Department of Care’ and ‘Department of Environment and Spatial Development’ play a central role in fostering healthy indoor environments at the Flemish level. Overall, Belgium is seen as a **frontrunner in IAQ regulation**, mainly due to the 2022 Federal Law and the Flemish Indoor Environment Decree (More info, see annex 5). Yet, all experts agree that issues persist. Comparatively, **Danish** policies on air quality are perceived as insufficiently innovative to tackle IAQ-related issues specifically. **Greece**, on the other hand, has no substantial IAQ directives in place. This prompted Greek experts to list more regulation as one of the most important interventions for managing indoor air quality. Currently, Greek policy frameworks mostly address outdoor air quality.

Views on the adequacy of existing regulatory frameworks for dealing with current IAQ challenges vary among Belgian experts. Some express that the **focus on outdoor air quality** has come at the expense of regulating indoor environments but note that this shortcoming is now being addressed (interviewees B1, B2, B3). Interviewee B2 contends that sufficient research has been conducted on IAQ in school environments, adding that most post-pandemic efforts have concentrated on promoting ventilation through CO₂ measurements. Instead, they suggest that nurseries and elderly care facilities may now offer greater potential for improvements. Other Belgian experts corroborate this view by citing various school-focused projects, though they simultaneously stress that there is always room for additional awareness campaigns and budget for renovation or construction.



Additionally, some Belgian interviewees express concern about the limited research on how IAQ specifically affects children's physical and cognitive health. They state that research more often looks at general aspects of air quality. Interviewees B3, who work closely with school personnel, report that poor ventilation is still a widespread issue in practice, as evidenced by CO₂ readings exceeding recommended thresholds. **This indicates that while existing Federal and Flemish regulatory frameworks are overall perceived as sufficient, their consistent implementation is still awaiting.**

Similarly, perceptions about the urgency with which IAQ is being treated differ. The Covid-19 pandemic has played a central role in increasing awareness about IAQ management, particularly in settings with vulnerable populations. However, according to several Belgian experts (interviewees B1, B3, B4) the sense of urgency has since decreased. Interviewees B3 add that this is partly due to a lack of financial budget, a constraint also mentioned by interviewee B6. Conversely, interviewee B2 notes that issues brought to the forefront by the Covid-19 pandemic, such as insufficient ventilation in schools and outdated building infrastructure, are now being tackled.

In **Denmark**, experts agree that current policies regarding air quality lack in specificity and scope to comprehensively tackle IAQ-related challenges. Reflecting on their experiences with air quality research in occupational environments, including offices, technical schools, and daycare centres, two Danish interviewees highlight a lack of national standards to manage IAQ. While D1 refers to the absence of regulatory standards for specific particles like ultrafine particles as well as chemical products, D2 suggests a shortfall in ventilation standards for public buildings, such as schools. D1 furthermore perceives Danish directives as conservative rather than innovative, noting that, concerning particle thresholds, outdoor air quality is better regulated (e.g., the Occupational Exposure Limit (OEL) for organic particulate matter is much higher than for outdoors). This indicates that while some regulations that can be applied to indoor environments – including schools –, they are perceived as not comprehensive enough to address all factors comprising IAQ.

In **Greece**, opinions range from existing frameworks being adequate to deal with IAQ challenges (G2) to – most prominently – current legislation being insufficient (G1 and G3). Similarly to Denmark, experts cite directives that contribute to improving IAQ like Health and Safety at Work mandates and anti-smoking laws. But here too, the focus currently lies on outdoor air quality monitoring, with experts voicing hopes that a unified European framework would help address the lack of IAQ guidelines in Greek legislation.

Although awareness of IAQ has increased and some regulatory progress has been made, particularly in school settings, experts across Belgium, Greece, and Denmark agree that managing IAQ in schools requires targeted efforts. While Belgian experts have a positive outlook, greater concerns about the adequacy of existing regulatory frameworks are raised in Denmark and Greece. To a varying extent, gaps persist in research, funding, and the consistent prioritisation of IAQ across all vulnerable indoor environments across all three countries.



3.2. Identified challenges of IAQ management in schools

IAQ management poses complex challenges (See Figure 3). Policymakers must navigate an intricate interplay of several factors, including environmental, infrastructural and (geo)political. At the same time, questions of social equity demand action across multiple environments, ranging from home and recreational spaces to school and work. Financial constraints complicate regulatory compliance and education in schools. Moreover, effective IAQ management strategies depend not only on awareness-raising campaigns but on fostering meaningful behavioural changes. Given the complexity of IAQ-related challenges, exploring all stakeholder perspectives can contribute to identifying context-specific challenges and opportunities.

The following subsections provide a comprehensive overview of the various challenges that were identified during the interviews:

(External) Environmental challenges

While experts note that many efforts have concentrated on improving outdoor air quality, the **interplay between outdoor and indoor** air remains a critical concern. Poor outdoor air quality due to traffic or industry emissions in urban and pesticides in agricultural areas will impact indoor air quality.

Practices commonly advertised as good for improving indoor air quality, such as opening windows to ventilate, can aggravate indoor air pollution in schools located near busy roads, industrial or agricultural zones. The **location of the school** has thus a direct impact on the quality of its indoor air, primarily because outdoor environmental conditions determine what pollutants infiltrate inside.

Policy related challenges

In practice, the **persisting regulatory focus on outdoor over indoor air quality** demonstrates the challenge of directing attention towards IAQ management. Because of the close interplay between outdoor and indoor air, Belgian experts express mixed opinions on whether outdoor and indoor air quality should be tackled separately, arguing that starting with improving outdoor air quality also leads to improvements in IAQ. Yet, as interviewee B2 also points out, humans spend 85-90% of their time indoors, which highlights the need to pay more dedicated attention to IAQ. The reliance on **ad-hoc measurements** or project-based data collection in IAQ research further undermines its importance in policy discourses, while outdoor air quality benefits from a well-established infrastructure with continuous monitoring both in Belgium, Greece, and Denmark.

"We mustn't forget indoor air either. Because when we talk about air quality in general, we assume that we are referring to outdoor air, while indoor air is definitely part of that too. But of course, to have healthy indoor air, we need healthy outdoor air. The same thing? No, that's not true, there's no denying it." (Interviewee B2, Belgium)

Additionally, air quality is not just a question of national regulation since air pollution cannot be contained within national borders. Due to **diverging air quality standards and risk contingency plans across Europe**, some countries may be exposed to their neighbour's emissions. Experts therefore advocate for a unified European approach, which must carefully evaluate whether to prioritise economic or health prospects. Interviewee B1



points out that better air quality generally leads to better health and consequently to lower health care spending, a factor not taken into account when evaluating the economic prospects of IAQ regulation in the EU, yet especially relevant for sensitive groups like asthmatics. Furthermore, different European countries have different communication and risk contingency plans, resulting in **different levels of awareness and risk protection behaviours among citizens**.

“European standards also consider what is economically feasible, and the best available techniques, whereas the World Health Organization does not take that into account. It looks at what is good for health. And there is still a very wide spectrum between the two.” (Interviewee B1, Belgium)

“Everyone thinks, “I’ll just install an air purification device and that will be fine.” Yes, but that doesn’t work in practice, does it? So, I think Europe could develop more frameworks in this area. [...] because every country is currently doing what it thinks is necessary, which is leading to a lot of differences.” (Interviewees B3, Belgium)

For policymakers, there is also the question of the necessary extent of regulation to improve IAQ management. Interviewee B6 argues that, at this stage, education and awareness-raising campaigns should be prioritised over policy-based solutions. In line with this, interviewee B4 advocates for regulation as a last resort measure, instead emphasising the importance of cultivating **intrinsic motivation** to improve IAQ. Meanwhile, Greek experts predominantly call for more forward-thinking policies, indicating significant gaps in guidelines focusing on schools, vulnerable groups and IAQ in general. As demonstrated by the quick scan analysis of directives and guidelines for indoor and outdoor air quality in phase 1 (See D8.2, and also annex 5 in D8.5), Belgium has already established policy measures that address IAQ while Greece sees significant gaps in IAQ regulation, which may explain the divergence in perspectives. Comparatively, despite mentioning some shortcomings of occupational environment regulation, interviewee D1 does not list policy interventions among their proposed solutions. Instead, they focus on behavioural and awareness-raising interventions, whereas interviewee D2 recommends enshrining IAQ guidelines in national legislation.

“There are still significant gaps in targeted IAQ regulations for schools and more proactive health-focused measures for youth. Greece could improve its response by integrating specific, actionable guidelines for IAQ in schools and other child-focused spaces and ensuring that vulnerable groups are at the heart of environmental health policies.” (Interviewee G1, Greece)

The interviews suggest that experts in countries, where IAQ directives are perceived as sufficient, such as Belgium, press for action whereas policymaking is prioritized in countries with a lack of IAQ regulation. This shows that policy can be useful to catalyse action towards IAQ improvement but should not be the only measure put in place.

Other challenges must be solved on the national level. Belgium, for example, struggles with a strong **lobby movement** in support of wood burning stoves and fossil fuel powered cars, which undermines stricter IAQ standards. A lack of transparency about lobby movements can further obstruct IAQ management and communication. Interviewee D1’s perspective on OELs being much higher than outdoor limit values and many air pollutants



not being regulated at all, illustrates the difficulties in formulating comprehensive policies. Additionally, both interviewees D1 and D2 note that OELs are negotiated not only based on health, but also on socio-economic factors and the working environment parties, indicating the potential need for trade-offs and multi-stakeholder deliberation.

Building related challenges: school infrastructure

In Belgium, some school buildings struggle with **poor infrastructure**. A lack of insulation or ventilation, single-glazed windows, and suboptimal window placement, often in combination with outdated heating systems such as oil-fired and gas boilers, negatively impact IAQ. Furthermore, in IAQ awareness-raising initiatives, much attention has been paid to CO₂ levels. Yet, while some schools are equipped with CO₂ meters, many are not. **Improper equipment of schools** is also a concern when it comes to adequate ventilation systems.

Infrastructural challenges are tightly linked to **budget limitations**, often causing tensions between improving IAQ and the context-specific priorities of school administrations. For example, school managers may face difficult choices between promoting ventilation and managing rising heating costs, whilst also providing education.

This is also a concern for Danish experts, who highlight the need for balancing sufficient ventilation with energy efficiency. High levels of CO₂ and air contamination through construction materials are seen as the most pressing issues for schools with respect to indoor air pollution, especially when ventilation is limited. Furthermore, they worry about mould and chemical reactions between products as well as too high temperatures in buildings.

Individual level: behaviour and awareness

IAQ management can place an **additional burden on teachers** who oftentimes lack adequate training and resources to maintain indoor air quality standards. School staff tend to have different priorities, making their engagement and investment in IAQ management strategies difficult, with decisions often left to premises managers and not teaching staff.

According to the interviewed experts, there currently is a **lack of awareness among teachers and pupils**. This manifests in behaviours that are counterproductive to IAQ improvement. For example, individuals may refrain from opening windows even for a short period of time due to fear of contracting illness. They may also sit too close to the windows, which is also influenced by the classroom setup and other infrastructural determinants. Additionally, windows or ventilation grills may be closed to prevent draughts. Conversely, when the room becomes too hot, teachers may habitually resort to opening the windows rather than turning down the temperature or opening the door to save heating costs. And as previously mentioned, opening windows to ventilate can, in some areas, be detrimental to IAQ, especially when individuals lack context-specific knowledge of their surroundings. Finally, perfumes and pollutants carried on clothing can inadvertently contribute to air contamination. Such behaviours suggest that people prioritise short-term effects like avoiding a draught or reducing noise over long-term impacts such as health outcomes due to exposure to poor IAQ.

Next to the previously detailed resource limitations faced by schools, motivations to tackle IAQ-related issues are also impacted by a **lack of visibility of (indoor) air**. The greater



attention to outdoor air quality in policy discourses as well as public awareness and education efforts has created the false impression that IAQ is not an issue, causing indoor environments to be perceived as safe. Poor IAQ only becomes a priority, when its long-term impacts become visible, for example, during peak Covid-19 times. The pandemic induced a temporary shift in discourse that put IAQ not only at the top of policy agendas but also brought it to the forefront of public consciousness. As previously mentioned, the **sense of urgency** surrounding IAQ has since abated but indicators of poor IAQ like a loss of concentration and increased tiredness among students can catalyse a similar awareness when explicitly linked to IAQ. Paired with training to manage IAQ, the **perception that air quality is uncontrollable**, mentioned as an issue by two experts, can also be tackled at the root.

Technological challenges

While technologies have the potential to facilitate IAQ management, individuals often lack understanding of how they work and how to use them, rendering technological solutions ineffective. Building occupants can be provided with technological solutions, but when there is a **lack of awareness and understanding** of how they work or they are used improperly, then the issue is not being solved.

Experts frequently refer to the improper **maintenance and usage** of ventilation devices, illustrating the lack of proper training and education deployed along with technological solutions. Furthermore, the installation of ventilation systems often imposes constraints on how people interact with their environment, for example, by disabling the possibility to open windows. The resulting lack of human control in IAQ management is perceived as dismissive of human culture and psychology. Similarly, buildings with high levels of insulation, such as passive houses, can draw in polluted air via their ventilation systems, especially in residential areas where wood-burning stoves are used. Dealing with such constraints, can be frustrating for people.

"They should also leave space for human interaction, such as the ability to open windows. That is something that is deeply ingrained in our culture. [...] People are wired to want to take action themselves and to have control over it." (Interviewee B2, Belgium)

Lastly, as previously mentioned, building occupants make trade-offs between human comfort, air quality and energy efficiency. Opening a door or window can offer a quick win for IAQ improvement. However, this simple action can also cause thermal discomfort, lead to issues with noise and increase energy demand. Occupants often close windows to preserve warmth or reduce noise, unintentionally causing under-ventilated and stale environments that impair concentration and health. The affordance lies in the intuitive ease and instant benefit of natural ventilation, while the constraint is the economic and environmental cost of heat loss.

Structural inequity challenges

Finally, we discuss challenges related to structural inequities, which are interconnected with the challenges and actions mentioned above.

Vulnerable groups, such as children and young adults, tend to be difficult to engage in science-based projects because they oftentimes lack the resources to participate. Such **structural inequities** frequently lead to their voices being underrepresented in decision-



making processes that directly impact their health and living conditions. For example, new mobility plans aiming at improving the living environment often focus on wealthy neighbourhoods, meaning the loudest, most resourceful voices stand out (labelled as voice inequality in Figure 2). IAQ management interventions that fail to account for structural inequities risk widening existing disparities.

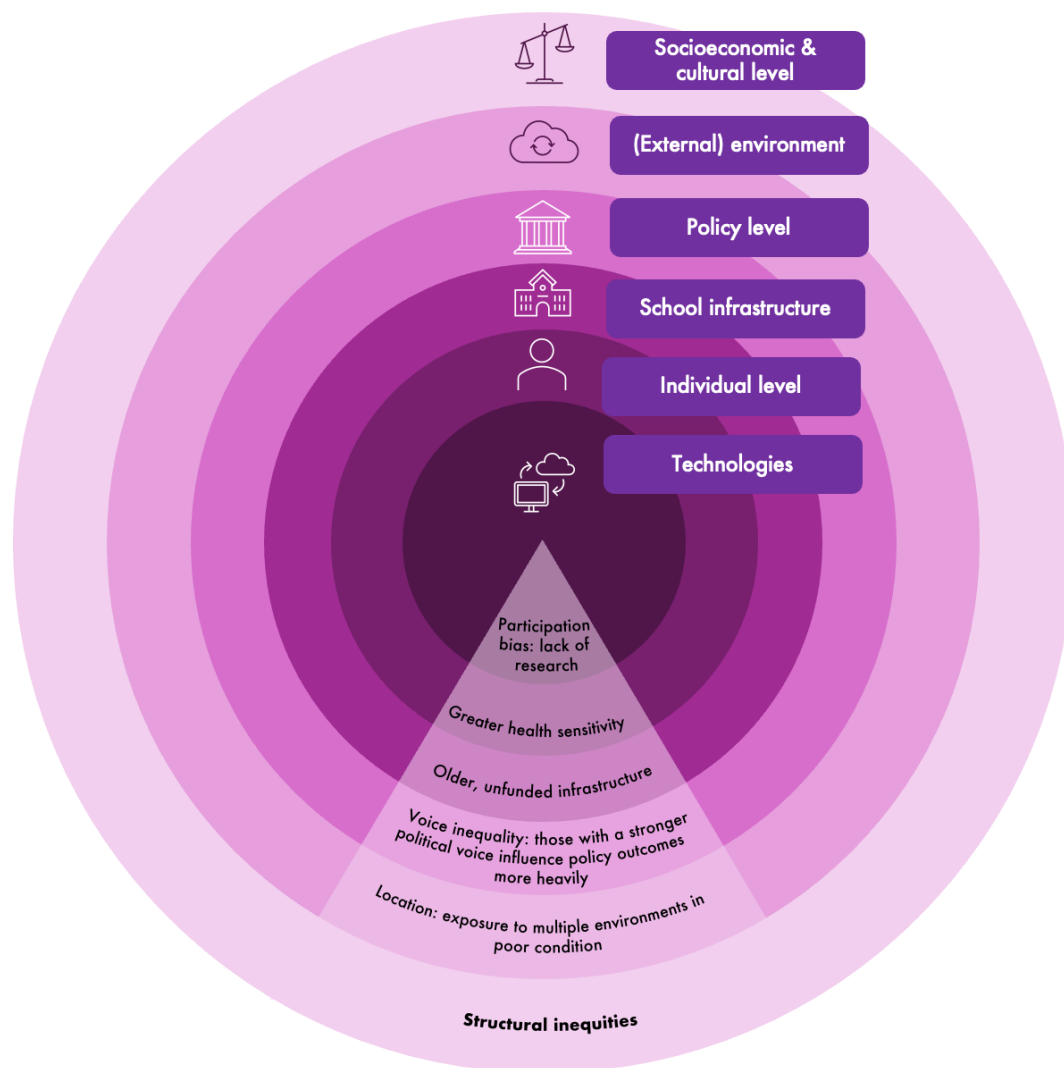
“It is difficult to reach them. They usually already live in disadvantaged neighbourhoods and are often also the victims of traffic measures, because these measures usually only take the loudest voices into account.” (Interviewee B1., Belgium)

Schools in low-income areas are especially affected by **budget limitations**. As a result, students from vulnerable backgrounds, who are already more exposed to poor air quality across multiple environments, are further marginalised.

Acknowledging a lack of IAQ interventions that proactively target vulnerable groups, one Belgian expert (interviewee B4) notes that devising separate guidelines for different groups may come at the cost of **clarity and feasibility** for their implementation by schools. At the same time, there is a tension between providing universal guidelines and tailoring interventions to context-specific needs and priorities. This is underscored by a perceived **lack of research** on vulnerable populations to inform policymaking. Therefore, effective IAQ policies must strike a balance between offering enough flexibility to schools and concretely addressing structural barriers to their implementation while being grounded in a solid evidence base.

“There is some research. But also, there isn't a big enough, clearly interpretable consensus on how it should be scaled up or down. This makes it difficult to create separate rules and regulations for everyone, as there are no general guidelines yet.” (Interviewee B2, Belgium)

“They must be sufficiently understandable, clear, and feasible. I think it is often more sustainable to have very specific regulations that schools can work with effectively, rather than an abundance of exceptions and additional rules that make it impossible for them to see the wood for the trees.” (Interviewee B6, Belgium)



Challenges

(External) environment

- Impact of outdoor on indoor air
- Location of the school (e.g., urban vs agricultural & high traffic vs low traffic areas)

Policy level

- Institutional discourse prioritizes outdoor air quality
- Ad-hoc approach for monitoring IAQ
- Diverging air quality standards and risk contingency plans across Europe; lack of a coherent, unified approach
- Formulating clear & feasible guidelines for all
- Lobby movements (for cars, fossil fuels & wood burning stoves)

School infrastructure

- Poor condition of school buildings (e.g., single-glazed windows, outdated heating systems, no or poor ventilation)
- Poorly equipped schools (e.g., no CO₂ measurement devices or ventilation systems)
- Lack of budget to address IAQ challenges (economic vs health priorities)
- Renovated school buildings: Potential risk of drawing in polluted air through ventilation, discomfort levels during summer
- Incorrect maintenance of ventilation systems

Individual level

- IAQ management as an additional burden on teachers
- Lack of awareness & training contributing to harmful habits
- Decreased sense of urgency since the Covid-19 pandemic
- Freedom and autonomy in managing IAQ versus control and enforced regulations
- False sense of urgency
- Perception that AQ is unattainable or uncontrollable

Technologies

- Proper maintenance & usage of ventilation systems
- Awareness and training among teachers & students about air ventilation and air filtration
- Affordances vs constraints (e.g., automation vs human agency, and quick wins versus heating costs)

Figure 2: IAQ-related challenges across identified levels.

3.3. Identified solutions for IAQ management in schools

While reflecting on the challenges related to IAQ management, the interviewed experts also addressed existing or potential improvement strategies (see Figure 3). Broadly, the identified solutions can be categorised into infrastructural, technological, policy and behavioural interventions.

However, the complexity of IAQ-related challenges requires a holistic approach to IAQ management. The interviews clarify that technologies are believed to afford better IAQ, shown by how devices and systems are always listed among proposed solutions. Simultaneously, experts note that without proper training or integration into relevant actors' everyday routines, ventilation and air filtration systems as well as IAQ measurement devices remain under- or misused. Meanwhile, regulation can compel individuals and school administrations to comply with standards but may undermine intrinsic motivation. Potential inconsistencies between individuals' actual beliefs and practices and how policymakers and engineers envision IAQ management, risk rendering interventions ineffective. Therefore, it is essential to understand that the proposed solutions are interconnected and demand a holistic approach in accordance with the needs of building occupants.

Environmental solutions

Given the close interaction between indoor and outdoor air quality, **improving immediate school surroundings** can also contribute to better IAQ. Implementing school streets that restrict traffic around schools during peak drop-off and pick-up times is seen as the main point of intervention for pollution caused by motorised vehicles, next to promoting alternative modes of transport.

Beyond traffic reduction, the **greening of school environments** presents a less widespread avenue for IAQ improvement (proposed both by interviewees in Belgium and Greece). Although its primary motivations encompass enhancing pupils' mental and physical well-being, expanding educational prospects and strengthening biodiversity, improved air quality, for example due to the air filtering effects of trees, hedges, and green roofs, is a welcome secondary benefit. Interviewees B5 warn, however, that greening interventions alone risk becoming band aid solutions, since they do not tackle the root causes of air pollution. Greening should therefore complement, not replace, other IAQ management strategies. To combat voice inequality and the consequent further marginalisation of vulnerable groups, a **proactive approach** to change rather than a demand-driven one is required. For instance, interviewees B5 propose prioritising schools that need the most improvement, for example based on socio-economic indicators or the level of green infrastructure available.

"In other words, we are going to give priority to disadvantaged schools because those children need it more. [...] So yes, if you want to work proactively and take certain indicators for social equality into account, then you will have to work more proactively."
(Interviewees B5, Belgium)



Policy interventions

From a policy perspective, several measures have been suggested to improve IAQ. Most prominently, experts mention setting **minimum IAQ thresholds** for schools. Given the geopolitical nature of air pollution, experts argue for harmonising regulations across Europe. A **European-wide approach** should encompass standards for ventilation and air purification, including the usage and maintenance of devices deployed for these purposes. It should also include guidelines on how to tackle exposure to a combination of different pollutants, whose impacts are being explored within the LEARN project.

"[...] national governments and the EU should establish guidelines and provide resources to ensure that all schools can benefit from better air quality: set minimum IAQ standards for schools, ensuring that building codes, ventilation requirements, and environmental regulations are enforced plus funding for implementation projects."
(Interviewee G1, Greece)

While the publication of the 2022 Flemish Indoor Environment Decree on IAQ is a first step, its reference values are non-binding, and it does not specifically mention vulnerable groups. But it could serve as a foundation for IAQ policymaking at the European level or inform other nations' policy frameworks, like Greece's. Two Greek experts note that, given a current lack of IAQ regulation in Greece, further alignment at the European level could be beneficial since it can facilitate the implementation of regulations on the national level. However, one Greek expert disagrees and says it is currently sufficient. Reinforcing the view that more harmonisation between European nations is welcome, one Danish interviewee bases their policy recommendation on Swedish legislation that sets minimum requirements for ventilation in public buildings.

Although several steps for better IAQ have already been taken in Belgium, Belgian experts align with the two Greek experts' perspective on this topic. Notably, they all highlight the need for more health-focused interventions, observing that many agencies and organisations discursively prioritize environmental over health targets.

"They could be a bit better coordinated. And I think that the starting point should always be the health of the user or resident." (Interviewees B3, Belgium)

One Belgian expert argues that devising separate guidelines for different groups comes at the cost of clarity and their feasibility, currently advising against specifically targeting vulnerable groups. Another Belgian expert recommends implementing a **general framework** first while research on how different vulnerable groups are affected by IAQ is still ongoing. Then, once a solid evidence base has been established, general guidelines should be **adjusted to cater to the specific needs of vulnerable groups**. This requires providing more funding for research that focuses, for example, on IAQ's impact on children's health and how ventilation mechanisms perform around children. One Greek expert, however, advocates for vulnerable groups being placed at the heart of environmental health policy, suggesting that frameworks should address their needs from the start.

While a unified European approach is welcomed, opinions diverge with respect to the implementation of **stricter or mandatory guidelines**. While some experts view current



European frameworks and especially their tightening in 2024, in order to align with WHO recommendations, as sufficiently forward-thinking, others advocate for stricter policies.

However, when stricter guidelines are proposed, it is in combination with other interventions, such as **providing more financial and educational resources to schools**. The introduction of a mandatory ventilation plan in elderly care facilities in 2025 in Belgium is cited by interviewee B4 as a good example. Implementing mandatory standards rather than recommendations can help but some experts caution against forced compliance since it can create resistance among some stakeholders. Especially schools and elderly care facilities that are already dealing with a multitude of different challenges can experience mandatory IAQ measures as an additional burden.

Solutions for school infrastructure

Infrastructural interventions are considered an important step for improving IAQ. Experts emphasize the need for significant investments in the **modernisation of school buildings**, particularly those with single-glazed windows, a lack of insulation or ventilation, suboptimal window placement, and outdated heating systems. Buildings can be upgraded with insulated windows, Heating, Ventilation and Air-Conditioning (HVAC) as well as other automatic and manual ventilation systems, and automatic and manual sun protection screens, depending on the needs of each school.

Additionally, rather than relying on central heating systems, interviewee B2 proposes classroom-based temperature regulation to make ventilation by opening windows more energy- and cost-efficient. Two Danish experts recommend keeping temperatures between 20 and 23 degrees while also highlighting the need for energy-efficient buildings. Furthermore, they advise avoiding conditions that could lead to mould formation in buildings and to restrict the number of children in a room to comply with CO₂ guidelines. Infrastructural measures should be applied both when planning new buildings and in existing ones.

"So this needs to remain a focus. I don't think it's improving, but we need to keep focusing on healthy indoor air. This applies to the construction of schools, the design of schools, and the use and maintenance of schools." (Interviewee B6, Belgium)

Nevertheless, technological interventions should be accompanied by **guidelines** to regulate their deployment, preferably on a European level.

"So, I definitely think that automating everything is not the way to go, but there do need to be standards and guidelines at European level for the assistive systems that are being developed." (Interviewee B2, Belgium)

Behavioural interventions

While legislation can accelerate improvements in IAQ management, intrinsically motivated behavioural changes tend to be more sustainable and create support from relevant stakeholders, including building owners or sector organisations, for example LOGO (lokaal-regionaal GezondheidsOverleg) in Belgium. On these grounds, **fostering a culture of change** is promoted over law enforcement.



"And if you look at it from a motivational point of view, intrinsic motivation is something you do yourself, something you find important, something you see the added value of. Is sustainable behavioural change something that it is chosen by you or because you will otherwise be fined?" (Interviewee B6, Belgium)

For this purpose, experts propose **coaching school personnel** in effective IAQ management. Since air quality is not only determined during the construction of school buildings but also throughout its lifelong usage, coaching should also target directors, prevention advisers, facility and quality managers, and technical services to ensure the proper usage and maintenance of ventilation systems. Intermediary organisations can help support schools in the development and execution of IAQ plans.

As part of a research project by the Department of Environment in Flanders, CO₂ levels are measured both in schools with and without mechanical ventilation systems, followed by recommendations for improvement. Some schools are provided with access to their real-time CO₂ data to monitor the success of the implemented recommendations. Additionally, they receive email alerts from the government when CO₂ levels exceed threshold levels, although immediate corrective action is not always feasible due to staffing or operational constraints. Alternatively, schools in Belgium have access to a self-evaluation questionnaire that helps them assess their IAQ management strategies and identify bottlenecks and successful interventions. After completion, schools are provided with actionable recommendations to improve IAQ, if necessary. However, schools are not proactively informed about the availability of this tool when planning renovations. By providing **monitoring support and practical recommendations**, governments and intermediary organisations can propel behavioural changes.

Continuous education should ensure that teachers and pupils are correctly informed about resource limitation, optimal ventilation, and air purification. This should include responsible product use, such as cleaning and painting materials, timings for ventilation in relation to heating system usage, the operation of relevant devices, and the efficacy of indoor plants for air purification. One Greek expert even proposes incorporating IAQ education into school curricula. Providing concrete recommendations may prove more actionable than general advice. For example, rather than just advising individuals to limit sources of indoor air pollutants, the Vlaams Instituut Gezond Leven is currently working on compiling a list with product labels to look out for when purchasing painting and construction supplies.

"Also, adopting green cleaning methods would contribute to better IAQ in schools, as well as incorporate IAQ awareness into their health education curricula." (Interviewee G1, Greece)

"And in an easy way, because those people don't have time to figure it all out either. So, we're now working on a kind of label list. [...] If you're going to paint or renovate, buy new furniture, you name it, find a product with these labels and then you're good to go. [...] But there's no legal obligation to use labelled products. It's just a recommendation." (Interviewee B6, Belgium)

Linking individual's lived experiences and experience-based knowledge to measurements and recommendations can make IAQ more tangible. For example, three interviewees in



Belgium note that teachers do notice changes in their students' behaviours with deteriorating IAQ but do not always link the symptoms like loss of concentration or increased agitation to IAQ. Supplementing this knowledge, rooted in the everyday lives of teachers and students, with evidence-based education can encourage individuals to make meaningful connections that in turn fosters intrinsic motivation since they produce tangible impacts.

Additionally, next to spotlighting IAQ's impacts on students and by extension, the (school) community, making individuals, in particular teachers, aware that managing IAQ positively impacts their own health, can also intrinsically motivate action.

"But I think every teacher has noticed when it gets warm, when the air makes all the pupils fall asleep. [...] That they actually see children's behaviour change throughout the year, throughout different air qualities, in fact throughout the day. I think they actually have a lot of information in their heads that they have noticed but have not linked to indoor air quality." (Interviewee B2, Belgium)

"When it comes to air quality, there is still so much potential to raise awareness and educate people about the fact that you have a headache, that you feel drowsy, or the fact that, well, you have a cold, and then you are told to stay indoors and keep everything closed up." (Interviewee B4, Belgium)

Finally, **citizen science** projects also serve as effective educational and awareness-raising tools. For example, students can measure air quality in and around their schools using low-cost sensors and analyse the impact of new circulation plans or building improvements. The value of investing in citizen science and otherwise participatory research projects can be derived from the interviews. A **bottom-up approach to IAQ management** can therefore not only help foster sustainable behavioural changes but also produce novel solutions.

"Because it's not just about informing, raising awareness, or installing a CO₂ meter. You have to work on different levels to achieve a good result." (Interviewees B3, Belgium)

Technological solutions

Technological interventions, while portrayed as effective, are predominantly seen as a part of IAQ management rather than stand-alone solutions. They can range from reducing emissions at their origin like **source limitation** to removing pollutants by building users. Source limitation can be achieved by using non-toxic, low-emission and sustainable materials and products. This includes cleaning products, which are often overused in the mistaken belief that higher doses lead to a cleaner environment, when in fact it can worsen IAQ.

While **air purification** can help, experts emphasize its supplementary role to source control and **ventilation**. Schools, like elderly care facilities, should be encouraged to devise ventilation plans that include using CO₂ meters to monitor air quality and conduct periodic evaluations. Danish experts also recommend equipping schools with CO₂ sensors to ensure acceptable thresholds are not exceeded, thereby supporting the use of CO₂ as a proxy for measuring good IAQ. At the same time, they – and interviewee D1 especially – direct attention towards additional sources of air pollution and pollutants, further backing source limitation a critical/ crucial intervention.



“So as not to have to blindly switch to air purification. So, I think that order is important: source control, ventilation, airing, and then air purification.” (Interviewee B6, Belgium)”

While ventilation is widely recognised as the primary measure to improve IAQ by experts across all countries, Belgian interviewees advise against its full automation. Instead, they recommend a combination of mechanical and manual ventilation, such as opening windows during breaks, advocating for maintaining **human agency in IAQ management**. The case against full automation is underpinned by the idea that cultivating **intrinsic motivation** to improve IAQ is better than relying on technological or policy-based fixes. This becomes especially relevant when considering questions of social equity. Despite children’s physiology and CO₂ emissions differing from adults’, ventilation devices are primarily tested on the latter. Therefore, their effectiveness in environments principally populated by children remains under-researched, meaning that, at least for now, **well-informed human intervention** may prove more effective. The interviews suggest that pairing technological solutions with behavioural interventions and education to empower users, rather than restricting their agency with fully automated systems and regulatory frameworks, is the preferred way forward.

“The question is sometimes whether this is clear enough for schools. That is difficult to assess because it is not their core business. They hear things like, “Oh yes, you can do this, you can do that,” but whether they fully understand the principle of source limitation, ventilation, airing, and air purification in that order is, I think, more difficult for them.” (Interviewee B6, Belgium)

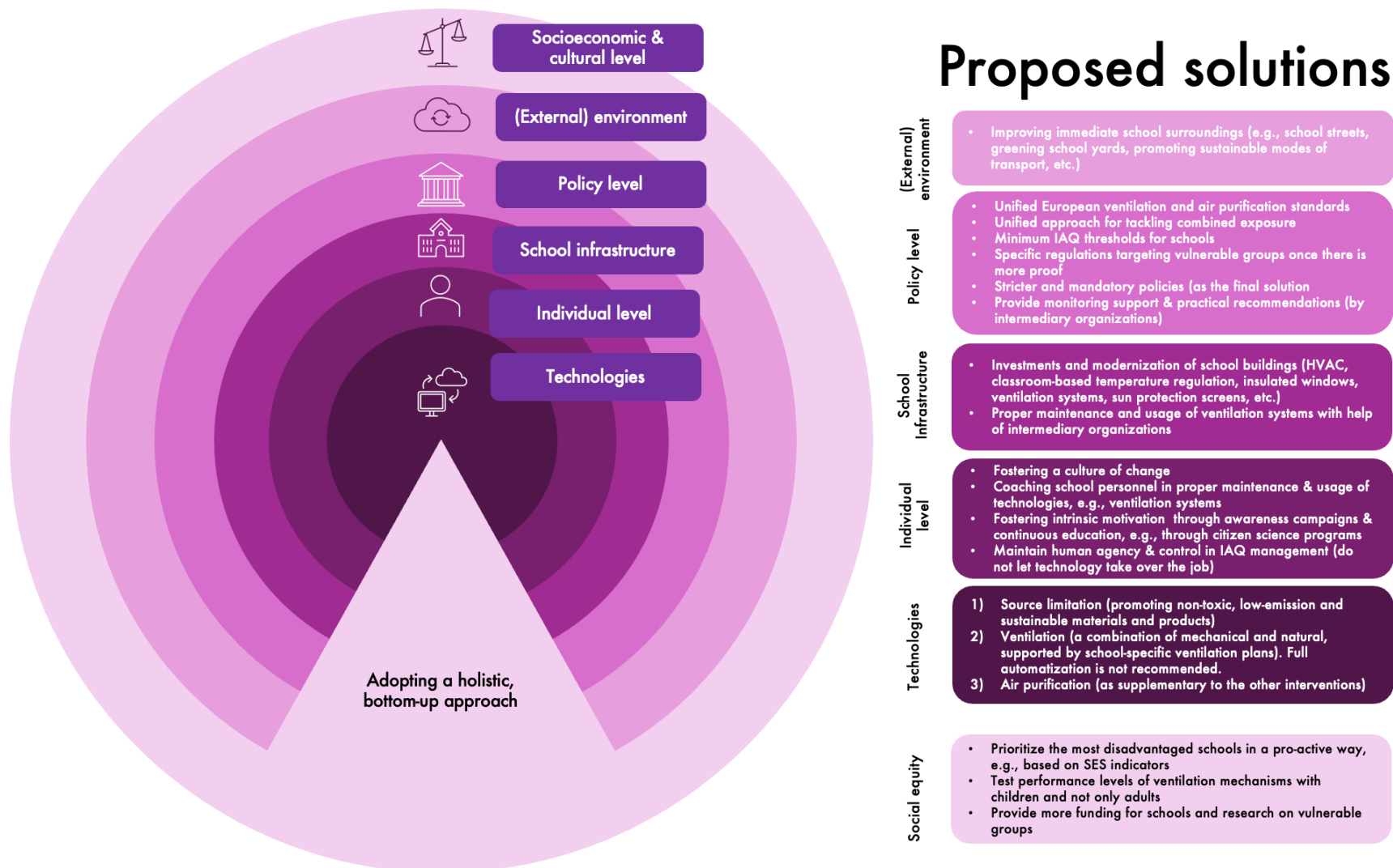


Figure 3: Proposed solutions to facilitate IAQ management in schools

4. Participation action II: Survey results

In the following subchapters, the survey results are presented. A total of 317 respondents completed the survey. The number of valid responses for each question is reported. Therefore, the total number of respondents may differ for each question. If any significant difference between the three countries is found, then these are reported.

4.1. Profile of the participants

With the help of a marketing agency, we specifically looked for respondents living in Belgium, Denmark and Greece above 27 years old and having children between 9 and 12 years old. Beyond that, the survey was also shared in the LEARN and IDEAL cluster networks. As such, the representation of countries is not that diverse, with 96% of the respondents either living in Belgium (31%), Greece (32%) or Denmark (31%), while the remaining subset is mostly living in other countries (e.g. Ireland, Germany, Australia, etc.). The preferred language is in accordance with the destined country, with respondents mostly answering in Greek (31%), Dutch (30%), Danish (24%), and English (15%).

The average age of the respondents is 43 years old (with the minimum age of 27 and the maximum age of 75 years old), and most respondents were female (58%). 74% of the respondents have one child between 9 and 12 years old, 23% two or more than 2 children, and 3% have no child in this age group.

Hence, most respondents also completed the questionnaire from the perspective of being a parent, or guardian of a child (95%). 8% of the respondents also completed specific questions around IAQ management in school environments, as being a teacher, principal, school nurse, facilities, maintenance, or other school staff.

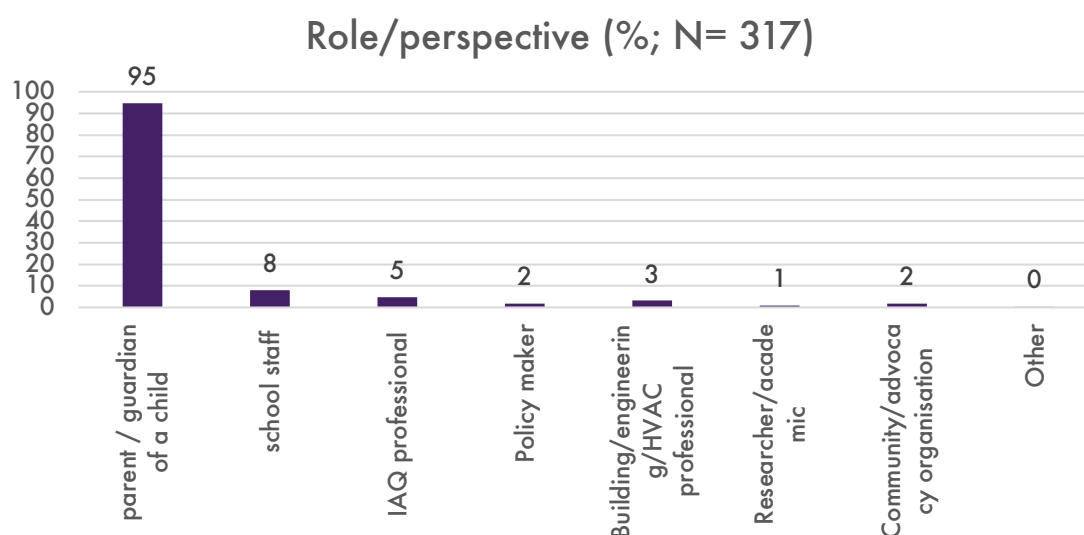


Figure 4: Role/perspective of the respondent completing the questionnaire – multiple roles possible (%; N=317).



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4.2. Awareness and knowledge about IAQ

4.2.1. Thinking frequency, perceived concerns and impact of IAQ

The questioned sample showcases a symmetrical, bell-shaped distribution in terms of how often they think about children's exposure to indoor air pollution at school (See Figure 5). 36% of respondents never or rarely think about children's exposure in school environments, while an almost similar percentage (33%) think about it often or always. Hereby, a significant difference was found amongst the three countries, with Belgian respondents thinking less frequently about indoor air pollution in school environments than Greek and Danish respondents ($\chi^2(8, N = 300) = 35.70, p < 0.01$).

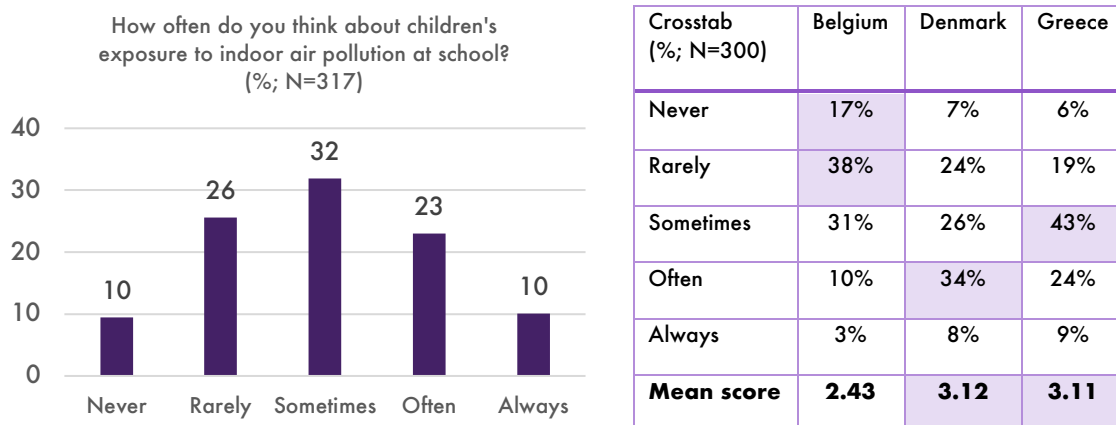


Figure 5: Frequency of thinking about IAQ in schools, including a crosstabulation per country.

Surprisingly, the concern scores are rather skewed to the right (See Figure 6). 43% are not at all or only slightly concerned about IAQ in schools. Once again, there are significant differences between countries: Belgian respondents are mostly not at all or only slightly concerned, while Danish respondents are mostly slightly concerned and Greek respondents somewhat to extremely concerned ($\chi^2(8, N = 300) = 39.1, p < 0.01$).

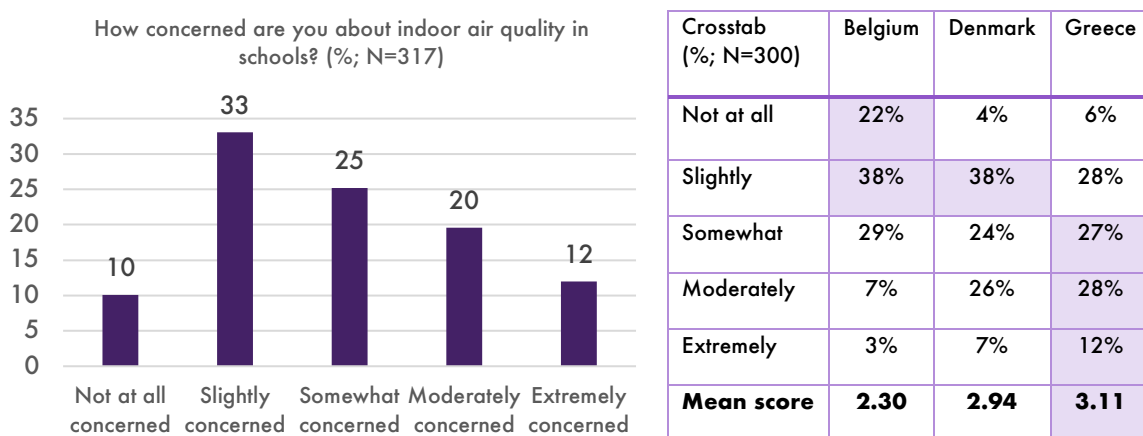


Figure 6: Frequency of concern scores about IAQ in schools, including a crosstabulation per country.

Conversely, the impact scores of IAQ on children are rather skewed to the left (See Figure 7), with 48% of the respondents believing that IAQ has a major or severe impact on children. Furthermore, Belgian respondents mostly think that indoor air pollution has a moderate impact on children, Greek respondents' opinions are rather spread from minor to severe, and while Danish respondents clearly think that it has a major impact.

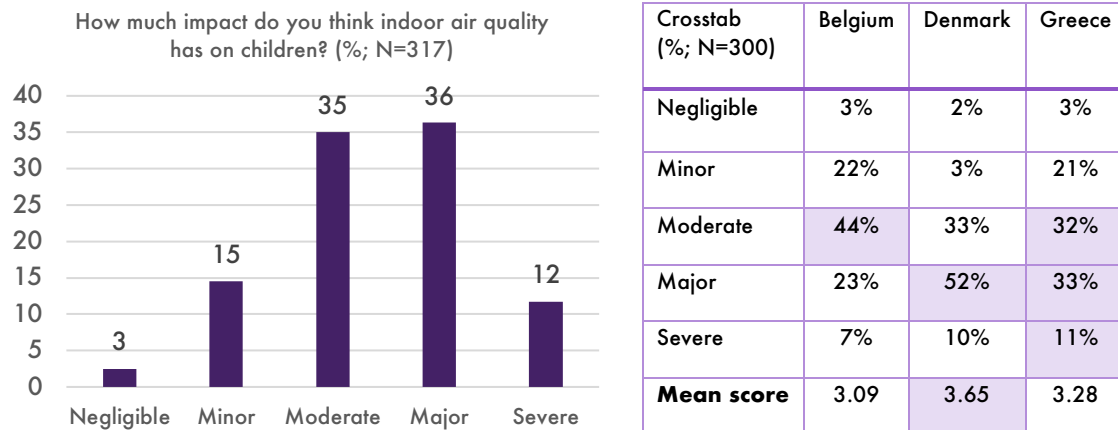


Figure 7: Frequency of impact scores about IAQ on children, including a crosstabulation per country.

Overall, IAQ in school environments seems to function as a moderately salient, but not dominant concern, as indicated by the frequency with which this issue is considered. Most respondents sit in the 'middle ground' of occasional reflection, with roughly one third at each extreme. Greek and Danish respondents also seem to think about this topic more frequently than Belgian respondents. By contrast, the concern scores skewed to the right (so, towards lower concern scores) showing that even when the topic is on people's minds, a substantial proportion do not interpret it as something to worry about. This suggests that 'thinking' about the topic does not automatically translate into feeling worried. Along these lines of thinking, Greek respondents seem to be the most aligned: they regularly think about the issue and also appear to be the most concerned.

However, the combination of lower average concern scores and higher perceived impact scores suggests a dissociation. One potential explanation for this result is that respondents are aware of the gravity of the potential effects, but believe that, for instance, the problem is under control in their own context, that existing IAQ guidelines in schools provide adequate protection, or that they do not see a high likelihood of impact for *their* children.

4.2.2. Management of IAQ in school environments

40% of respondents agree that schools are managing IAQ in an adequate manner (See Figure 8). However, a large proportion of respondents either have no clear opinion on this matter (26% neither agree nor disagree) or do not know (11%). 24% have rather a negative opinion on this, and it also seems that opinions differ across countries, although this association is not strictly linear ($\chi^2(8, N = 265) = 17.4, p = .026$). Respondents in Greece seem to be the most 'positive' (mean score: 3.54) about adequate IAQ management in schools, followed by those in Belgium. Danish respondents are rather neutral on this topic, with 35% neither agreeing nor disagreeing.

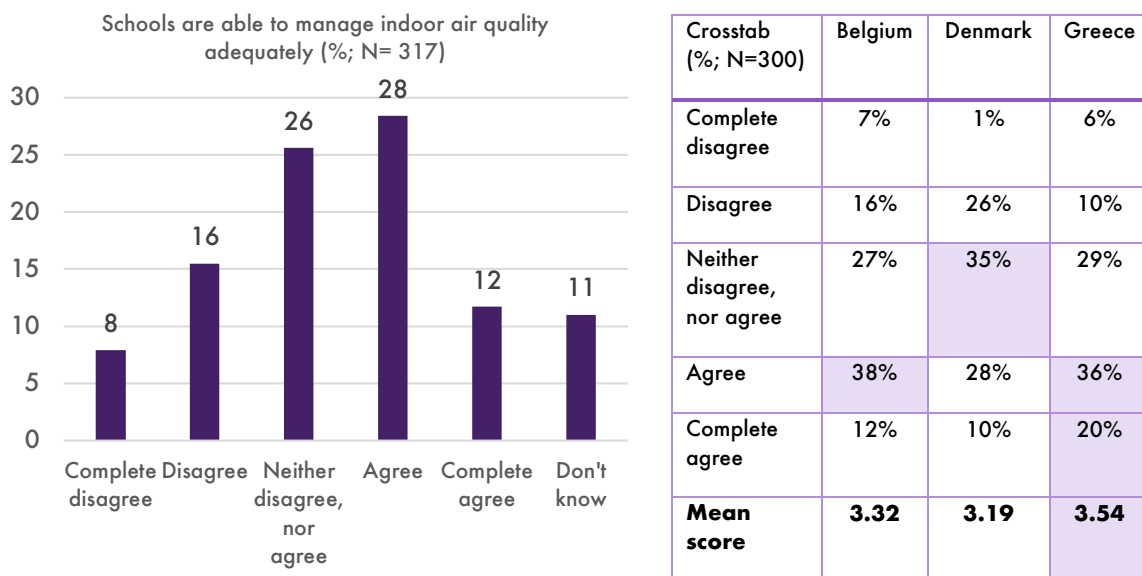
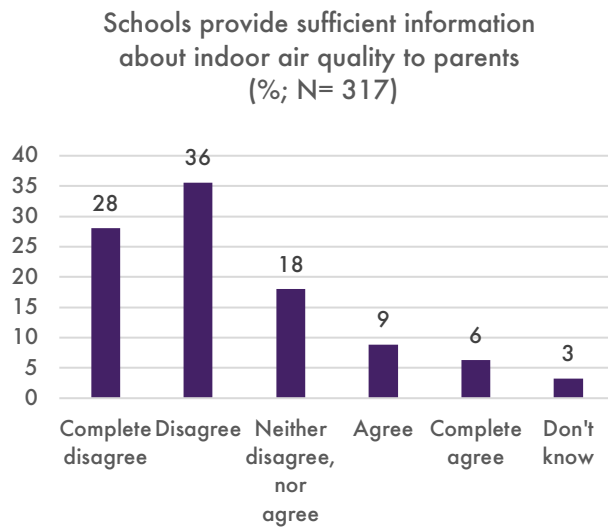


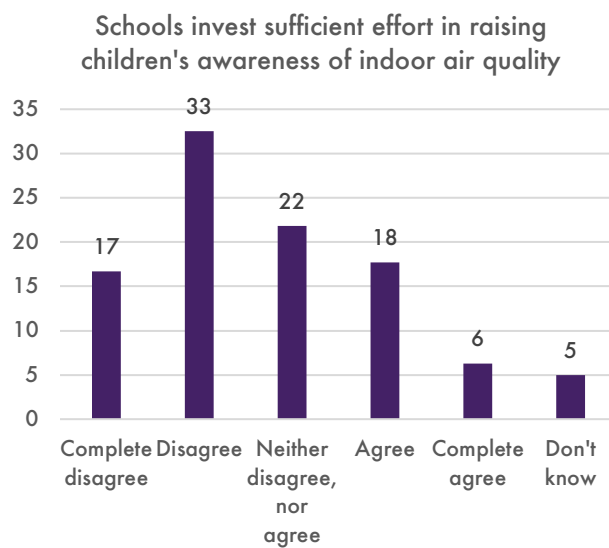
Figure 8: Frequency of perceived capacity of schools to manage IAQ, including a crosstabulation per country (complete disagree = 1 – complete agree =5).

In contrast to the diverted opinions on how well schools manage IAQ, the respondents clearly indicate that schools do not provide parents with sufficient information on this topic (See Figure 9). 64% of the sample either completely or generally disagrees that sufficient information is provided; only 15% have a positive opinion on this matter. Furthermore, no significant differences were found between the three countries, meaning all respondents had the same view on this matter. When asked if schools invest sufficient effort in raising children's awareness, the results are more positive but still inclined towards a negative opinion (See Figure 10). 50% of the sample completely or generally disagrees that sufficient effort is being invested in raising children's awareness of this topic; only 34% has a positive opinion on this matter. A significant association was found between the three countries, although it was almost borderline ($\chi^2(8, N = 284) = 16.7, p = .034$). Danish respondents seem the most positive about this issue, followed by Belgian respondents, although the overall average scores are low.



Crosstab (%; N=300)	Belgium	Denmark	Greece
Complete disagree	26%	22%	28%
Disagree	36%	35%	45%
Neither disagree, nor agree	19%	20%	20%
Agree	14%	9%	6%
Complete agree	5%	14%	2%
Mean score	2.38	2.57	2.10

Figure 9: Frequency of sufficient information provision to parents, including a crosstabulation per country (complete disagree = 1 – complete agree =5).



Crosstab (%; N=300)	Belgium	Denmark	Greece
Complete disagree	19%	10%	13%
Disagree	25%	36%	44%
Neither disagree, nor agree	23%	22%	28%
Agree	26%	23%	10%
Complete agree	7%	10%	5%
Mean score	2.77	2.87	2.50

Figure 10: Frequency of sufficient awareness raising of children, including a crosstabulation per country (complete disagree = 1 – complete agree =5).

4.3. Dilemma voting for policy solutions

In the questionnaire, respondents were invited to take part in a voting exercise based on dilemmas. Respondents were asked to choose between two options for five different dilemmas, all of which involved significant trade-offs for improving IAQ management in schools (See Table 2). The five dilemmas were developed based on the problem definition in phase I of the PAR4P method (see D8.2), as well as the challenges and solutions identified in phase 3 - participatory action I (i.e. the in-depth interviews with experts and policymakers). The dilemmas covered different dimensions of IAQ management, in specific the legislative or policy dimension, technology usage and individual or behavioural dimensions. To help them make an informed choice, respondents were provided with background information on the potential drawbacks and opportunities of voting for a particular option. In addition, some background information was provided in the questionnaire on how IAQ is currently regulated in Europe, with some examples of best practices. For each dilemma, respondents had the opportunity to argument their choice in an open text box (not mandatory).

Three of the five dilemmas were also shared on the LEARN project's LinkedIn page, as part of a promotional campaign. The outreach numbers are provided in Annex VI – Outreach of the polling campaign on LinkedIn. Overall, the online campaign had 718 views.

Table 2: Dilemma voting for policy solutions for IAQ management in schools: ‘What is the best solution?’

Dilemma	Option I	Option II	Shared on LinkedIn Page
1	National indoor air quality guidelines and standards	Indoor air quality guidelines and standards for all EU member states	No
2	Mandatory norms and regulations that everybody has to comply with	Flexible guidelines to support the management of indoor air quality based on motivation	Yes
3	Simple and universal indoor air quality regulation	Targeted protection for vulnerable groups	Yes
4	Full automation of indoor air quality management through technologies	Human control and agency in indoor air quality management	Yes
5	Making schools and teachers responsible for indoor air quality management	Making local government and agencies responsible for indoor air quality management	No

4.3.1. Dilemma 1 : National versus EU guidelines & standards

The first dilemma focusses on the level of policy implementation of new IAQ guidelines and standards, whereby overall respondents prefer it to be implemented on the **national level**. However, a significant difference was found among the three countries ($\chi^2(2, N = 300) = 23.6, p < .001$), whereby we clearly see that Danish respondents prefer national guidelines, Greek respondents prefer EU guidelines and Belgian respondents do not have a clear preference.

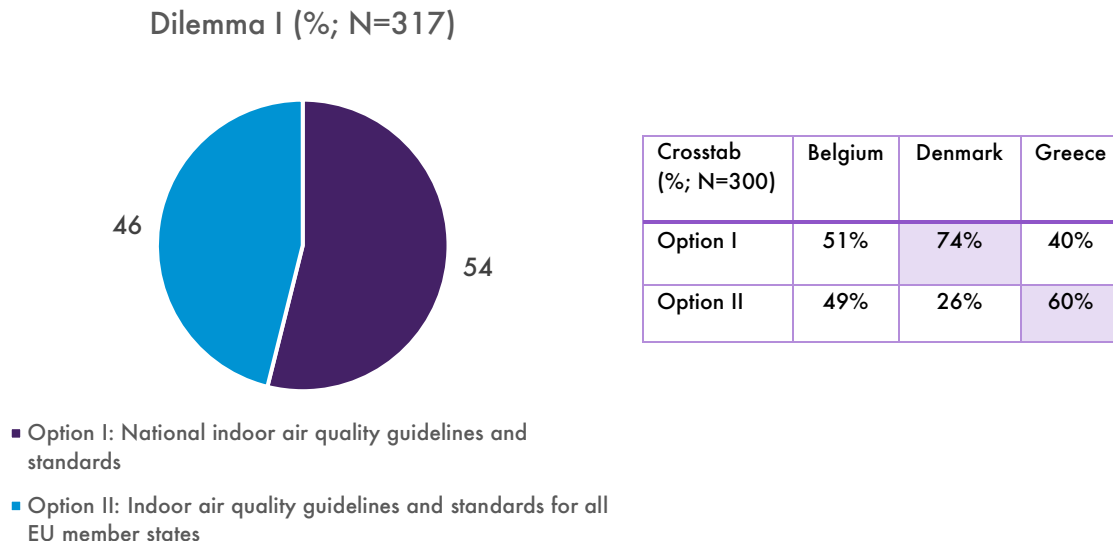


Figure 11: Dilemma 1 'national versus EU guidelines & standards', including a crosstabulation per country.

97 respondents also provided a reasoning for their preference; through open qualitative coding we found the following main arguments:

Option I 'National' arguments	Option II 'EU' arguments
A. It takes into consideration the local context of buildings and the outdoor climate, each country knows its own needs at best (20%) B. National guidelines are considered to be implemented more efficient and quicker (13%) C. There is more trust in the efficiency of national implementation than in the EU government (2%)	D. Uniformity: guidelines and standards are more efficient, fairer and obligatory for all (29%) E. More trust in the EU government than the local government (11%) F. Current guidelines are not good enough (1%)

When we compare the arguments among the three countries, it is clear that Greek respondents prefer EU guidelines & standards due to trust issues in their national government (See quotes below), while Danish respondents stress the local contextualization that is necessary as well as Belgian respondents, who also opt for European uniformity in an equal matter.

Examples of quotes:

"Countries differ in terms of temperature, outdoor pollution and so on; therefore, each country should decide for itself what is best"

(Danish respondent, argument A)

"If we have to wait for a European agreement, we could be waiting for years"

(Belgian respondent, argument B)

"I want less EU regulations inside my country"

(Danish respondent, argument C)

"I trust the EU more than the government"

(Greek respondent, argument E)

"Having the same rules everywhere makes things much clearer for everyone"

(Belgian respondent, argument D)

"Mandated standards that are the same for all countries ensure equity of application"

(Other country respondent, argument D)



4.3.2. Dilemma 2: Mandatory versus flexible guidelines

The respondents had a clear, outspoken opinion on the second dilemma: IAQ norms and regulations should be made mandatory (see Figure 12). During the interviews, one Belgian expert put forward a strong argument against mandatory guidelines, stating that experience had proven that it is often easier to organise collaborative partnerships with sector organisations based on intrinsic drivers. The expert supported this statement with the argument that gradual behavioural change would be more effective than imposing new regulations simply because they must be followed. However, the results of the questionnaire make it clear that most respondents prefer a top-down approach, and that respondents from all three countries agree in a similar way (no significant difference found).

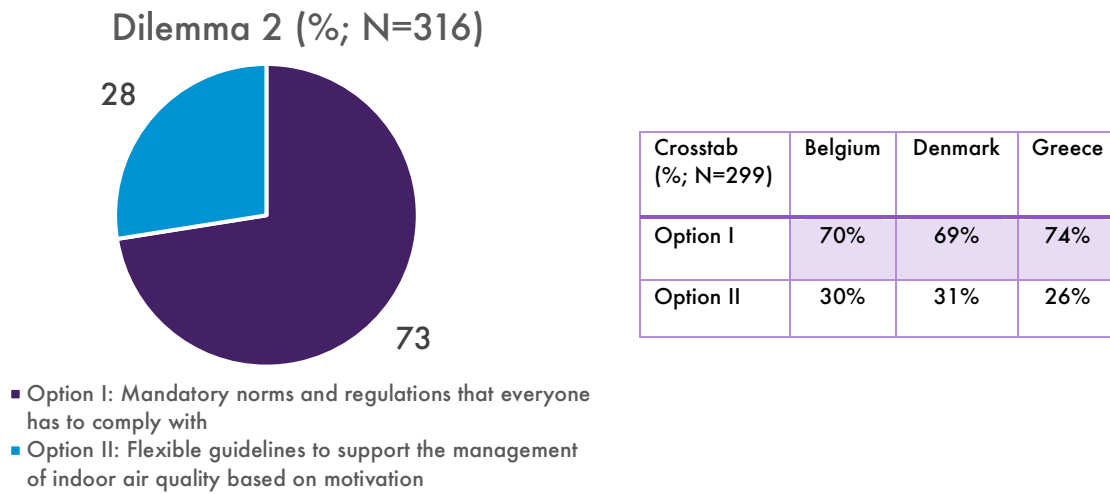


Figure 12: Dilemma 2 'mandatory versus flexibles norms and regulations', including a crosstabulation per country.

75 respondents also provided a reasoning for their preference; through open qualitative coding we found the following main arguments:

Option I 'Mandatory' argument	Option II 'flexible' arguments
A. If it is mandatory then rules will be followed, and it will be clearer and more universal for all (65%)	B. Countries and public buildings should still be able to tailor the guidelines (9%)
	C. If you address the right motivation its change will be more successful (3%)
	D. We need less rules (6%)

Similar arguments can be found across all three countries, whereby Greek respondents were most eager to provide argument A. Some respondents also provided a combination of arguments, whereby a minimum standard is made obligatory and higher standards are implemented as flexible options. Another respondent also referred to the live monitoring of [IAQ in public schools in Boston](#), whereby CO₂ and PM measurements are made publicly available through a dashboard.

Examples of quotes:

"Rules concerning our children's health must be mandatory"
(Greek respondent, argument A)

"Unless there is an obligation, no action will be taken"
(Belgian respondent, argument A)

"I would prefer a combination of both: mandatory minimum requirements and flexible guidelines that allow for better and higher scores"
(Belgian respondent, argument A and B)

"With the right motivation, there is a better chance of success"
(Greek respondent, argument C)

"Tired of mandatory guidelines"
(Danish respondent, argument D)

4.3.3. Dilemma 3: Universal versus tailored protection

Likewise the second dilemma, the third dilemma also has an outspoken opinion whether the IAQ standards and regulations should be applicable for all, or that they should include tailored protection for vulnerable groups, such as children (See Figure 13) – 81% prefers simple and universal IAQ regulation. From the crosstabulation, it is also clear that no significant differences can be found amongst the three countries, and that all agree with simple and universal guidelines for all.

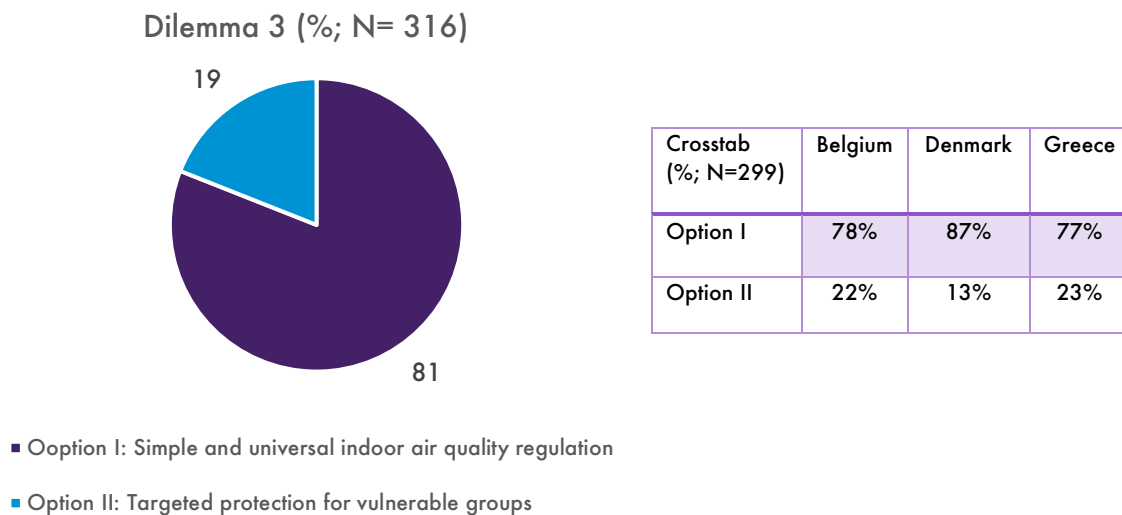


Figure 13: Dilemma 3 'universal regulation for all versus targeted protection, including a crosstabulation per country.

67 respondents also provided a reasoning for their preference; through open qualitative coding we found the following main arguments

Option I 'universal for all' argument	Option II 'targeted protection' arguments
A. It is a universal right to have clean air for everyone, we can all be vulnerable (60%)	D. Tailored and targeted protection is needed for some groups in society (12%)
B. More feasible, practical and simpler to follow guidelines (4%)	E. Vulnerable groups need more protection (6%)
C. Targeted regulation is unfeasible (4%)	

Similar arguments can be found across all three countries, whereby Greek and Belgian respondents were most eager to provide argument A. Interestingly, some respondents argue that everyone will become vulnerable over time and that targeted protection is practically unfeasible. Therefore, universal and simple protection for 'everyone' is being put forward as the ultimate solution in order to make it safe for everyone, everywhere and at all times.

Examples of quotes:

"Vulnerable groups are everywhere.

The only way to make it safe for the vulnerable is to make it safe everywhere. It is also important to remember that those deemed 'not vulnerable' are at risk of becoming vulnerable at any time - better IAQ reduces that risk."

(Other country respondent, argument A)

"Protections must be universal to be genuinely inclusive. Vulnerable students (and vulnerable family members) attend EVERY school and are in EVERY classroom. Importantly, their vulnerability is typically invisible - making targeted protections impossible to implement effectively"

(Other country respondent, argument C)

"We must look after vulnerable groups"

(Danish respondent, argument E)

"I think this is a feasible and practical solution."

(Belgian respondent, argument B)

"Otherwise, it becomes too complicated. It is also possible to have general rules and, in addition, specific rules for particularly vulnerable individuals, groups or places. As long as there are rules for everyone, not just vulnerable groups"

(Danish respondent, argument A and D)

4.3.4. Dilemma 4: Full automation versus human control

Technologies such as air filtration and HVAC systems can improve indoor air quality. However, during the interviews, some experts suggested that the experience of using these new technologies is not always optimal, particularly in newly renovated buildings. Users often prefer to open windows and manually control the IAQ in each room. In the questionnaire, 65% of respondents preferred full automation of IAQ management (see Figure 14), and no significant differences were found amongst the three countries.

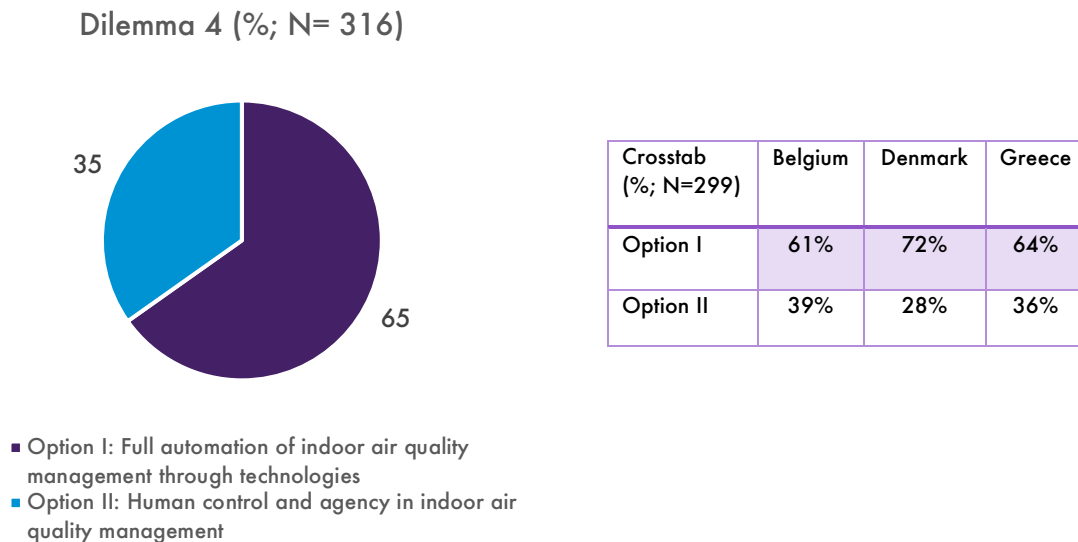


Figure 14: Dilemma 4 ‘full automation versus human control’, including a crosstabulation per country.

58 respondents also provided a reasoning for their preference; through open qualitative coding we found the following main arguments:

Option I ‘full automation’ argument	Option II ‘human control’ arguments
A. It is easier and more performative (24%) B. More reliable and accurate than humans (28%) C. No interference of humans (3%) D. Energy savings (7%)	E. The outcome will be better: people control better (9%) F. Technology should not control or automate our lives (3%)

Similar responses can be found amongst the three countries, with Belgian respondents mostly stressing argument A and Greek respondents argument B.

Examples of quotes:

"Automated procedures are more likely to have efficient results"
(Other country respondent, argument A)

"There is no trust in the human factor"
(Greek respondent, argument B)

"They do not depend on whether or not the competent authorities are willing"
(Greek respondent, argument C)

"In general, there is potential for greater energy savings"
(Greek respondent, argument D)

"Human oversight is always better and always works"
(Belgian respondent, argument E)

"Relying too much on technology isn't a good idea"
(Belgian respondent, argument F)

4.3.5. Dilemma 5: School versus government responsibilities

For the final dilemma, 57% of the respondents agreed that local governments and agencies should be responsible for IAQ management in schools (See Figure 15). Overall, there was no significant difference among the three countries, although responses were less decisive in Greece, clearer in Denmark and especially Belgium.

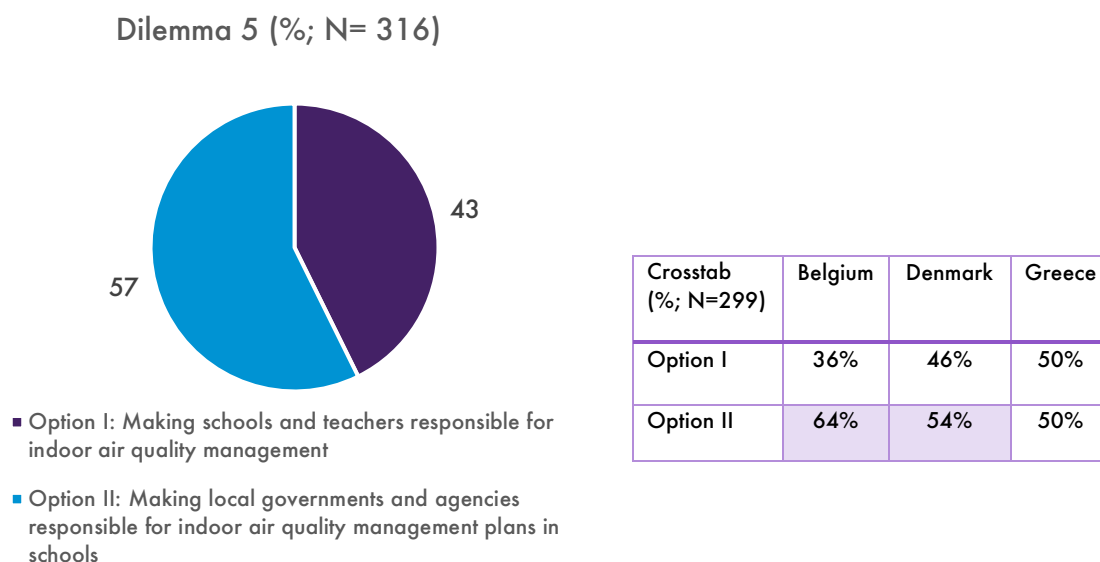


Figure 15: Dilemma 5 'school versus government responsibilities', including a crosstabulation per country.

58 respondents also provided a reasoning for their preference; through open qualitative coding we found the following main arguments:

Option I 'school's responsibility' argument	Option II 'Government's responsibility' arguments
A. Those who know it best should be involved: they have the best understanding, and it will lead to quicker results (18%) B. Localised responsibility: schools should be able to take decisions (18%)	C. Schools do not have the time nor the skills to manage IAQ (12%) D. It is a core responsibility of the government: it is an expected system-level responsibility (29%) E. It is centralised (2%)

Arguments are differing amongst the three countries, with Greek respondents being diverted amongst argument A and B, and argument D, while Belgian respondents are mostly pointing to a system-level responsibility of governments for IAQ management. Danish respondents did not provide many arguments, those who did mostly provided argument A and B.

Examples of quotes:

"It would be better if the teachers who are also the most involved were the ones to take part" (Greek respondent, argument A)

"Teachers are responsible in their workplace"
(Greek respondent, argument B)

"Teachers already have too many responsibilities"
(Danish respondent, argument C)

"The government should be responsible and provide qualified staff"
(Danish respondent, argument D)



4.4. Prioritization of solutions

After the dilemma questions, respondents made a top three prioritization of solutions to improve IAQ management in school environments. These solutions were pre-identified through the expert interviews of participatory action I, and which were grouped in Figure 2.

The first round of voting was between technology implementation and infrastructural and behavioural priorities. Here, we see that 'renovation or upgrading of school buildings' was voted into first place with a score of 52%. Second place went to the implementation of IAQ monitoring with 36%, followed by raising awareness among children in third place with 62%. These results point to a preference for structural actions first, i.e. to improve the buildings (which could also be regarded as a way of providing better education for their children), then monitor IAQ and only then focus on awareness-raising.

Table 3: Technology versus infrastructure versus behavioural priorities

	Monitor air quality (N=301)	Renovate or upgrade school buildings (N=305)	Teach children about air quality (N=294)
1	45%	52%	7%
2	36%	30%	31%
3	19%	18%	62%

The second round of voting focused solely on technological challenges, with air ventilation receiving 54% of the vote and taking first place. This was followed by air filtration improvement in second place with 39% and air quality monitoring in third place with 54%. The respondents clearly favoured increasing fresh-air supply through ventilation as the core intervention, following by improving air filtration and then systematic air quality monitoring. This ordering aligns with the expert interviews and shows that ventilation and filtration are key levers for IAQ, while monitoring supports those measures.

Table 4: Ventilation versus filtration versus monitoring

	Improve air ventilation (N= 307)	Improve air filtration (N=299)	Improve air quality monitoring (N=294)
1	54%	30%	19%
2	32%	39%	26%
3	14%	30%	54%

4.5. Questions for school staff

A specific section of the questionnaire was designed for school professionals, including teachers, principals, school nurses, facilities and maintenance staff, and other school staff. Those who indicated at the outset that they could answer the questionnaire from this perspective were directed to these questions (see Chapter 4.1: Profile of the Participants). All questions were completed by 76 respondents. For each question, there was also an 'I do not know' option, which was excluded from the calculation of the mean scores (see Table 5). The following six questions were answered using a five-point Likert scale, whereby a higher mean score indicated greater alignment with the statement. Although mean scores per country were also calculated, these should be interpreted with caution due to the small sample size. We cannot state if these differ significantly.

Table 5: Questions for school staff (5-point Likert scale: completely disagree (1) to completely agree (5)).

Statement	Valid N	Overall st. dev	Overall mean score	Mean score Belgium	Mean score Denmark	Mean score Greece
There is not enough information available for school staff to do anything about IAQ	79	.95	3.65	3.75 (N=20)	3.63 (N=30)	3.58 (N=26)
IAQ management places an extra burden on school staff	84	1.13	3.43	3.62 (N=21)	3.73 (N=30)	3.13 (N=30)
IAQ is not an urgent topic anymore since the COVID-19 pandemic	85	1.34	2.75	3.71 (N=21)	2.77 (N=31)	2.23 (N=30)
There is not enough budget for the school to effectively manage IAQ	83	1.11	3.90	4.20 (N=20)	3.77 (N=30)	3.87 (N=30)
Ventilation systems are not well maintained in the school	81	0.82	4.11	4.33 (N=18)	3.87 (N=30)	4.13 (N=30)
My school has an effective IAQ management plan	76	1.13	2.72	3.11 (N=18)	3.00 (N=29)	2.21 (N=29)

There is a strong perception that **ventilation systems are not well maintained** in schools (overall mean score 4.11), while school staff also indicate that schools do **not** have **effective IAQ management plans** (overall mean score 2.72), especially in Greece (mean score 2.21). Overall, there is similarly strong perception that **budget** is insufficient for effective IAQ management (overall mean 3.90, highest in Belgium).

Most respondents feel that IAQ management adds an **extra burden** on already busy school staff (overall mean 3.43), particularly in Denmark and Belgium. School staff also generally agree that there is not enough information available to act on IAQ (overall mean 3.65, slightly higher in Belgium). The **perceived urgency to act** on IAQ appears ambivalent, with an overall mean score of 2.75, indicating that most respondents neither disagreed, nor agreed. This score is the lowest in Greece, and the highest in Belgium, suggesting national differences in policy emphasis and post-pandemic dilution of urgency.

Together, these patterns suggest that IAQ management in schools is currently constrained by a combination of **structural factors**: inadequate funding, poorly maintained ventilation systems, and a lack of clear implementable IAQ management plans. From these results, we conclude that IAQ is seen as a **“systems’ problem”**, embedded in building infrastructure and institutional routines. The ambiguity about urgency may reflect the post-pandemic fatigue: IAQ moved from a crisis topic to a ‘normal’ school concern, but without a clear routine to manage it. Furthermore, there is prevalent disconnect between technical knowledge and classroom practice: engineers and policy makers may design guidelines and IAQ solutions, but for now, school staff do not perceive these as clear or actionable. This is particularly notable in Belgium, where the sense of insufficiency and lack of guidance is highest, despite a relatively high number of recent awareness-raising campaigns and tools compared to Denmark or Greece (See D8.2 and Annex V - Updates Phase 1). This suggests that awareness alone may not suffice to translate IAQ policy into perceived capacity and routine practice in schools.

4.6. Questions answered by children

The final section of the survey was designed to be completed by children with their parents or guardians. If respondents have more than one child aged between 9 and 12 years old, then they completed this section with one of them. Participation was voluntary, and the child could withdraw from participation at any time. As mentioned in Chapter 4.1 (Profile of the participants), 74% of the respondents have one child between 9 and 12 years old, 23% two or more than 2 children, and 3% have no children in this age group.

77% of the parents agreed to take the survey together with their child. The children were asked to provide a general satisfaction score about the indoor air quality in the classroom, through a happy (score 5) or sad (score 1) face. The average satisfaction score provided by the children was **3.38/5**, indicating **moderate to good IAQ** in the classroom. There was no significant difference found between the three countries, although the results were borderline, indicating a potential difference between Belgian (mean score 3.6) and Danish respondents (mean score 3.42) with relatively higher scores, than Greek respondents (mean score 3.25).

Overall, 54% of children said that poor indoor air quality affects how they feel or learn a little bit, while 26% said it has a major effect (7% not at all, and 13% does not know). Although no significant difference was found in the overall satisfaction rating, one was found in how children feel the air affects their feelings and learning ($X^2(6, N = 240) = 25.2, p < .001$). Hereby, we see that Greek respondents rather perceive a lot of impact on how they feel or learn, while this is less the case for Danish and Belgian respondents (See Figure 15).

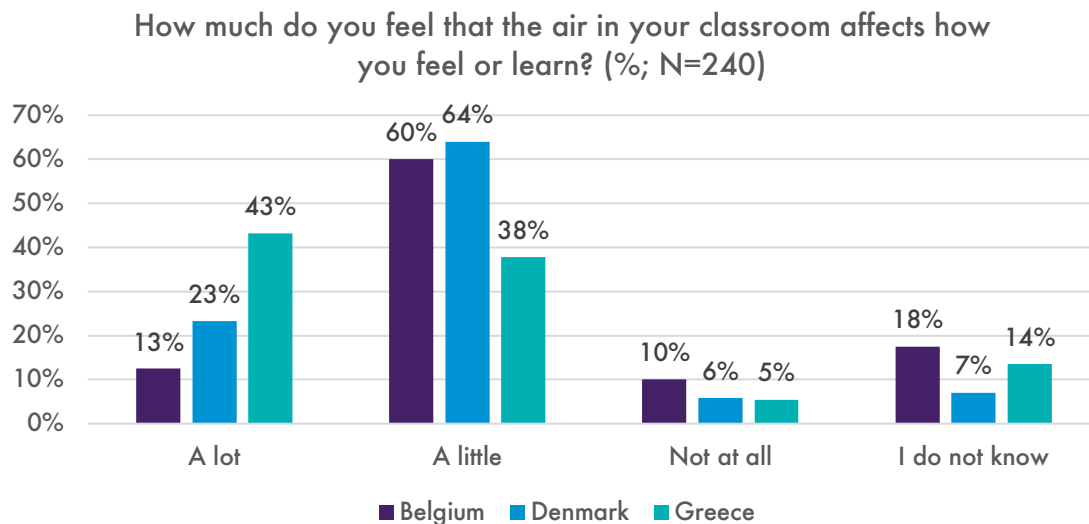


Figure 16: Country comparison of IAQ on how children feel or learn (%; N=240).

Overall, when asked if their teacher or school is doing enough to keep the air in the classroom clean and healthy, most children indicate that some things are being done (56%) or a lot of things are being done (14%). 20% say that they are not doing enough, while 14% think they are doing a lot (and 10% does not know). No significant differences were found amongst the three countries.

Remarkably, **52% of the children do not notify the teacher when they think the air in the room is bad**, while 42% do signal it and 7% do not know. The finding that half of the children do not notify their teacher can be due to several reasons, such as feeling uncertain about their responsibility to alert the teacher, a feeling of insecurity to interrupt the lessons, classroom dynamics, or the lack of awareness that air quality concerns can be expressed as part of a routine (e.g. a window-opening rule). A significant difference was found among the three countries (See Figure 15): children in Belgium alerted their teachers less frequently than those in Greece, and even less frequently than those in Denmark ($\chi^2(2, N = 226) = 12.24, p < .001$).

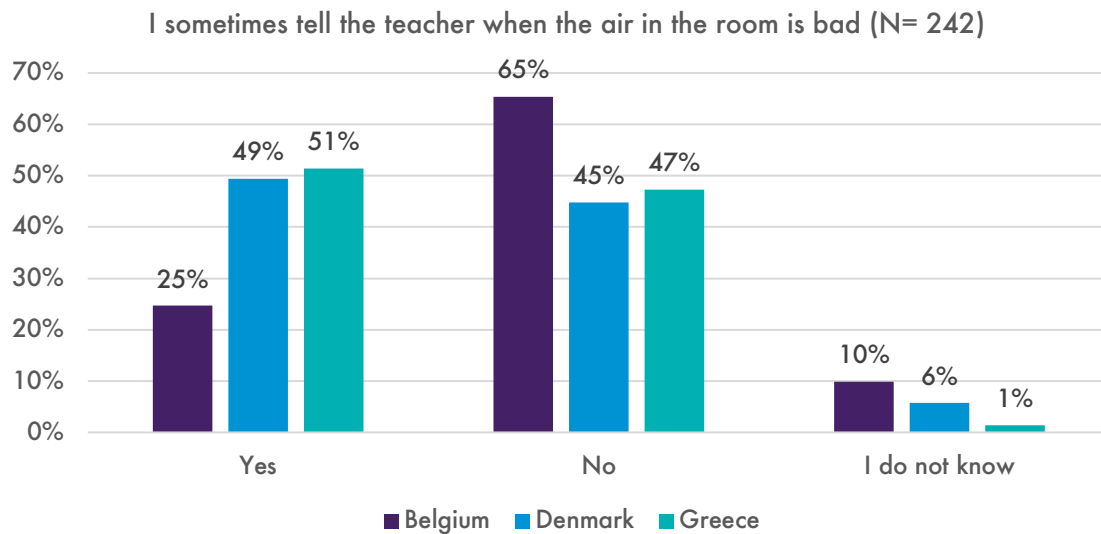


Figure 17: Country comparison of children alerting their teacher when the air in the room is bad (%; N=242)

At the same time, most children indicate a willingness to help their teacher keep the air fresh in the classroom (90%), and almost 80% express a desire to learn more about healthy indoor air at school. Together, these findings point to a need for **more explicit and empowering IAQ approaches**, in which children are both informed about air quality and given safe, structured ways to communicate when the air feels unhealthy.

5. Conclusions: Guidelines for new policy recommendations

In this final chapter, we conclude the PAR4-P method with its final phase, namely the formulation of guidelines for new policy recommendations for IAQ management in school environments. These inputs are taken in consideration in T8.3 led by NIA to write the LEARN policy brief.

IAQ guidelines and standards

- **Building trust for new guidelines:** Our results show conflicting opinions among policymakers and survey respondents regarding whether new IAQ guidelines, regulations and standards should be implemented at a national or EU level (with experts preferring EU regulations, while survey respondents did not). From the problem definition phase, we concluded that Belgium was the most advanced in providing concrete IAQ regulations for public spaces (See the 2022 Flemish Indoor Environment Decree on IAQ, more info see Annex V), whereas less prevalent frameworks were found in Denmark and Greece in particular. Some Belgian experts concluded that the policymaking phase is now at a mature stage and that the focus should be on implementing and improving specific sectors (e.g. nurseries or elderly care facilities). Overall, the experts plead for minimum IAQ thresholds for schools, with a European-wide approach that highlights the need for specific health targets, and not only environmental ones. Overall, survey respondents slightly preferred national indoor air quality guidelines (54% agreed), as national legislation is considered more efficient and quicker to implement, and is best suited to the local situation. Although there is no clear standpoint on this matter, trust is an important factor for the government institution that will eventually release them, as evidenced by the significant differences observed in Belgium, Denmark and Greece.
- **Mandatory and universal for all:** Respondents clearly favoured to make new guidelines around IAQ mandatory (71% agrees), as it will be more practical, simpler and feasible to follow guidelines. Hereby, the basic line of thinking is that they should take everyone in consideration (81%) **and** not release specific targeted protection measures for vulnerable groups (as everyone in time can become vulnerable). Although most experts also favoured mandatory standards, there are some nuances to be made. Some experts advocated for placing vulnerable groups at the heart of new research studies, so that guidelines can be directly adjusted to specific needs of those who need it the most. Furthermore, experts advised prioritising those schools that need it the most. These include those in areas with heavy traffic, limited access to green spaces, and often situated in low-income areas.

Technology measures for IAQ management

- **Affordances of full automation:** 65% of respondents prefer full automation of IAQ management through technologies, as this would be easier, more performative and more accurate than humans. However, a critical stance on this matter was raised during the expert interviews that from experience, human control (such as opening windows) is still necessary – which is especially the case for newly renovated buildings.



- **Monitoring support:** The measurement of CO₂ levels in combination with an alert system when thresholds are exceeded. Local governmental organisations can support schools in creating dashboards and alert systems, similar to what is set up in [public schools in Boston](#).
- **Adopt a holistic approach:** Relying solely on technology will not make the difference, technologies will afford better IAQ but it is also about proper training on how to use these devices, maintain them and integrate them into the routines of schools.

IAQ management in schools

- **Towards a structured approach:** A structured approach for IAQ management in schools is recommended that treats indoor air not as a one-off technical fix, but as a systemic and continuous program. Only 4 in 10 survey respondents agree that schools are managing IAQ in an adequate manner, while the school staff clearly indicates that ventilation systems are *not* well maintained and there is no clear management plan. Furthermore, 64% of respondents indicate that not enough information is provided to the parents about this issue. A structured approach could focus on communication, education, refinement of routines and act on proper maintenance of systems.
- **System-level responsibility of governments:** 57% of respondents regard the development of IAQ management plans for schools as a governmental responsibility. The provision of a budget and resources for renovating or upgrading school buildings was deemed a priority by 52%.
- **Empowering IAQ approaches for children:** Our survey results show that children are willing to help their teacher keep the air healthy indoors (90% agree) and are eager to learn more about the topic (80% agree). Providing age-appropriate lessons on IAQ (e.g. playing the LEARN board game) enables children to understand why it is important for their health, what pollutants are, and how ventilation helps. Furthermore, they can be involved in practical tasks such as opening windows, checking CO₂ sensors or using fresh air signals (e.g. hand signs) when the room feels stuffy. This gives children a sense of ownership and responsibility, and they know they can alert the teacher if necessary; as opposed to the current situation where only 52% of children notify their teacher when the air is bad.

Awareness raising and behaviour change

- **Broad IAQ campaigns:** Although we found several good practices of IAQ campaigns, especially in Belgium, it is remarkable that **43% of respondents are not all or only slightly concerned about IAQ in schools**. However, from cross-country comparative analysis, we did find that Greek respondents think the most frequently about the issue and are also the most worried. Furthermore, a dissociation was found between lower average concern scores and higher perceived impact scores. This indicates that respondents are aware of the gravity of health impact, but do not see a likelihood of impact for *-their-* children, or for *-their-* specific school context ('It is serious, but not for us'). Awareness and behaviour change campaigns can help by narrowing this gap by making risks more



personal and visible (e.g. show the learning effects to children as demonstrated in LEARN) and apply risk communication frameworks that stress that IAQ is not somewhere else's problem, but everyone's.

- **Awareness raising among school staff:** The results clearly point to a lack of knowledge about how to ventilate and usage HVAC-systems among school staff. Dedicated info sessions could be organised for school staff about the recognition of health complaints among pupils, which mitigation measures can be taken for different scenarios (e.g. when to open windows, or openings up doors), as well as small tips on how to involve children in IAQ management.

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Annex I – Interview with policy makers & experts (phase III)

Background information

- What is your profession?

Current policies on indoor air quality

- To what extent are you familiar with air quality directives – are you using or reading these frameworks in the context of your occupancy?
- Can you give a specific reference to a directive/guideline/policy framework for indoor air quality management (WHO, EU, Belgium or other countries)?
 - For instance, Belgium: Are you familiar with “Aanneming van de wet inzake binnenluchtkwaliteit” (November 2022)
- From your experience, do you see a difference in how policy frameworks are monitoring and controlling indoor versus outdoor air quality?
- To what extent do you think that current policies or directive are sufficiently innovative to deal with current challenges around indoor air quality?

Environmental justice

- Can you give some examples of projects or initiatives that study children’s health?
- To what extent do you think that current policy initiatives are addressing specific needs of different target groups, in specific vulnerable groups such as youth?
- Do you see an ethical issue in air quality management, whereby vulnerable groups are not properly addressed or reached with the right measures?

Guidelines / interventions for school environments

- To what extent do you think that indoor air pollution is an issue in school environments?
 - Can you have some examples of projects or initiatives that you have done to study it?
- According to your opinion, what can be done to improve the indoor air quality in school environments?
 - On the level of building materials and styles
 - On the level of energy and sustainability practices
 - On the level of occupant behaviour
 - On the level of awareness raising and dissemination
- Do you think these guidelines should be implemented locally/individually by each school or regulated on the Flemish/federal/European level?



Annex II - Workshop Script

Objective of the workshops

The objective of the workshop is to organise a collective and inclusive decision making process around indoor air quality management. Therefore, parents (as the voice for their children) are interrogated about their concerns, wishes, and prospective solutions they envision to improve indoor air quality in school environments.

This workshop specifically focusses on the inclusion of parents and their children. Two workshops are organised, with minimum 6 to maximum 10 participants, each workshop lasts for 1h30 minutes:

- **One workshop at the start of the clinical trial:** discuss the current indoor air quality in the school environment: what are challenges, effects, causes and concerns etc.
- **One workshop at the end of the clinical trial:** discuss the results of the clinical trials and formulate guidelines for policy recommendations based on it

The two workshops are organised at least *one time* per country. The participants receive an incentive upon participation, i.e. a free boardgame (if desired) and a voucher (15 euros per workshop).

The children are also invited at the same time to play the boardgame under supervision of a volunteer / student. Therefore, two rooms should be provided: (1) organising the workshop, (2) playing the boardgame.

Role division of the workshops

VUB:

- moderates the interactive workshops in Dutch or English, if English is not possible then the help of the local partner is necessary.
- provides a template invitation, agenda, topic list of questions
- analyses the results and reports it in the deliverable
- can foresee students for the pilot in Belgium to play the boardgame

ARHUS, UH, Environmetrics:

- Moderate the sessions in their local language if English is not possible (2 moderators)
- Provide volunteer support for playing the board game
- Send out the invitation to the stakeholders
- Provide photographs of the workshop results and provide translations
- Pilots review the final deliverable

Invite

For inviting parents to the workshop, a flyer is provided by VUB and FI to share it with the school. The flyer can be printed to distribute it among the children, and can be uploaded digitally on a school platform. There is also a sign-up form through Qualtrics to monitor the number of attendees. If there are not enough participants (less than six), the workshop should be cancelled.



Figure : Preview invitation for schools in Belgium (in Dutch)

Setting of the location

Per location, there needs to be one room for the workshop with the parents and another room for the children to play the board game. The rooms can be next to each other. Passage from one room to another should be avoided in order to keep attention and focus.

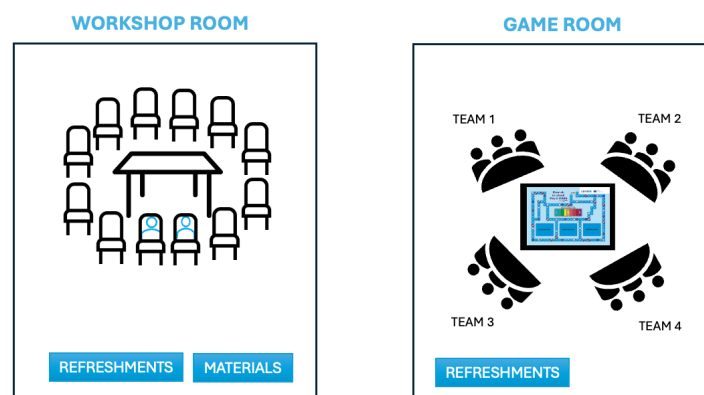


Figure 18: Room setting.

Workshop process in detail

The total duration of the workshop is 1 hour and 30 minutes. Since the short duration of the workshop, there is no in-between break organised. We advise that two moderators are available from the LEARN project to guide the participants, and one volunteer/student for playing the board game with the children.

0	Preparation of the workshop + game room	'30
1	Welcome	'5
2	Warm up: get to know each other	'5
3	Introduction of the LEARN project	'15
4	Session 1: Problem definition of IAQ in a school environment	'30
5	Session 2: IAQ platform	'30
6	Next steps and outro	'5
7	Debriefing and cleaning up	'30

Preparation (30 min)

Objectives	• Prepare the location before the participants arrive • Final briefing of moderators and volunteers / students
Approach	• Setting up the workshop room: ○ A table with refreshments ○ 12 chairs in a circle (10 participants' chairs, 2 moderator chairs) and one table in the middle ○ A table with the workshop materials for the moderators • Setting up the game room: ○ A table with refreshments ○ Tables in pairs ○ 1 board game of LEARN
Materials	• Agenda • Participant list • Pens • Templates • Audio recording • Consent form • Goodies (board games and vouchers) + receipt form

Welcome (5 min)

Objectives	• Welcome the participants • Divide the participants among the two rooms
Approach	• Welcome the participants at the door and mark their name on the list • Ask parents to sign the consent form for their participation in the workshop • Give a badge to the participant to write their name • Refer to the refreshment table • Invite them to take a seat • The volunteer /student guides the children to the conjoint room
Materials	• Agenda • Participant list • Pens • Templates • Audio recording • Consent form • Goodies (board games and vouchers) + sign form

Warm-up (5 min)

Objectives	• Short introduction of everyone around the table
Approach	• The moderator welcomes everyone and briefly introduces the objective of the workshop: "We are here today to reflect about indoor air quality in a school environment. At this school, a clinical trial is soon taking place to investigate the health and cognitive impacts of indoor air quality, and test new air ventilation techniques. In this context, we would like to hear the concerns, thoughts and reflections of parents. We will introduce you the project and then we will have a debate about indoor air quality management, and the publication of the collected results on a platform". • Tour de table, everyone gets introduced: name, profession and completes the following sentences: • "My biggest concern about indoor air quality is ... because ..." • "My biggest hope for indoor air quality isbecause..."
Materials	/

Introduction: The LEARN project (15 min)

Objectives	Short and accessible presentation of the LEARN project
Approach	- The moderator gives a brief, easy-to-understand presentation, without scientific jargon about the LEARN project. The participants can follow the presentation via the laptop or tablet of the moderator or scan the QR code to see the text and graphics from close by. - Participants gave the opportunity to ask questions
Materials	Link to the PPT presentation in English (please provide translations)

Discussion I: problem definition of IAQ in school environments (30 min)

Objectives	- To formulate the main challenge of IAQ in school environments - To identify the status quo of opinions related to IAQ before the results of the clinical trial
Approach	Moderation: It is a group exercise, but if participants like they can elaborate (in pairs or individually) on a separate A3 template. Explain the exercise: The participants are invited for a half hour discussion about the main challenge they see around IAQ in their school environment. From that defined challenge, they explore the root causes, the effects and potential solutions. They can write their answers on post it notes and stick it on the A3 template, which is centrally placed on the table. Similar answers are clustered and labelled with a common theme label. The participant reads his/her answer out loud before it is added to the template. This exercise defines the status quo of thinking around IAQ, without knowing yet the results of the clinical trial. In the second workshop, we come back to these initial thoughts and build further upon it. The challenge: First, a common challenge is formulated (also for those working separately). The participants need to agree about the main challenge they see for their school related to indoor air quality. The moderator asks if everyone agrees about the challenge and writes it down in the central box. The roots: Next, the causes of the challenge are identified The effects: Next, the impacts of the challenge are identified The solutions: Finally, the solutions and wishes for the future are identified Timing (if less time is needed, please proceed to the next step): - Define the challenge (6 min)

	• Define root causes (6 min) • Define effects (6 min) • Define solutions and wishes for the future (6 min) • Share the results: the A3 templates are discussed in group (6 min)
Materials	• Tree-root template (A3 template printed: 3 times, please translate) • Post-its

Discuss and cluster causes, effects and solutions

Start by discussing each cause one-by-one, adding them through a post-it. When similar items are mentioned, cluster them together and label the clusters with a theme. After ten minutes, switch to effects, followed by potential solutions or dreams for the future.



What are potential solutions?
What do you hope for the future?



What are the effects of this challenge?



What are the root causes of this challenge?



Figure 19: Tree-root templates (identification of challenges, root causes and effects)

Discussion II: IAQ platform (30 min)

Next steps and outro (5 min)

Objectives	- Participants feel appreciated for their contribution - Participants know what will happen with their inputs
Approach	- The moderator thanks the participants for their contribution to the LEARN project - The moderator explains that in a next step the results will be summarized and presented in the second workshop to check its validity. During the second workshop, the results of the clinical trial are presented and then the participants can react to their former given answers and explain if their way of thinking has changed. - Based on the provided solutions, recommendations will be summarized that will be published in a policy brief to distribute among other initiatives and policy makers in Europe. - Provide the opportunity for participants to ask extra questions - Thank the participants and provide the incentive. They sign a letter of receipt. - Turn off the audio recording
Materials	15 vouchers and letter of receipt

Debriefing and cleaning up (30 min)

Objectives	- Collect all results - Clean the rooms
Approach	- The moderator takes photographs of all the templates + post-its - The moderator writes the date and school location on top of the template (in order not to mix results from different schools) - The photographs, consent forms and receipt forms are shared with VUB through email Debriefing with all moderators and volunteers/students: - What worked well? What went wrong? - Do we have to change the approach? - Please send the feedback to VUB
Materials	Photographs of the results

Full list of materials for the workshops

- 1 agenda
- 1 participant list
- 1 audio recorder
- 10 consent forms
- 10 receipt forms
- 10 vouchers (each country can choose the store)
- LEARN board game (1 for the game room, and extra as incentive for participants)
- A3 template "Tree-roots": printed 3 times
- Post-its (3 different colours)
- Pens (15)
- Smartphone to take photographs of the results



Annex III – Survey template

LEARN - participatory survey

Start of Block: Welcome

Q1 The 'LEARN' project is a European research initiative that aims to evaluate the impact of indoor air quality on children's health at school. This survey explores the challenges of managing **indoor air quality in schools**, particularly in primary education, and the potential solutions to these issues. We would like to hear the views of children (9 - 12 years old), parents, school staff, maintenance staff and other experts on the issues they consider to be the most pressing. Based on your responses, the LEARN project will develop a set of **policy recommendations** aimed at improving indoor air quality in schools across Europe and protecting the health of children. The survey should take approximately **15 minutes** to complete. In case of any questions, you can contact projectlearn.heu@gmail.com

End of Block: Welcome

Start of Block: Informed consent

Q2 **Informed consent for participation** You are invited to take part in this survey about indoor air quality in schools. The survey is organised by the Vrije Universiteit Brussel (VUB, Belgium), a partner of the LEARN project. Your participation is entirely voluntary and you can stop at any time without facing any consequences. The data you provide will only be used for research and policy development purposes, with the aim of improving indoor air quality in schools across Europe. Your responses will be handled confidentially and stored securely. If you have questions or if you wish to exercise your rights, you can contact the data protection officer of VUB (dpo@vub.be). Through this link you can download the full informed consent. If you agree to participate, please select the option below:

- ☐ **I agree to participate in this research study (1)**

End of Block: Informed consent

Start of Block: Entry questions

Q3 **Introduction** First, we ask a few questions about your background. Where do you live?

▼ Austria (1) ... Other country (28)



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Q4 Did your child's school participate in the LEARN project, which studied indoor air quality in classrooms?

- ☐ Yes (1)
- ☐ No (2)
- ☐ I don't know (3)

Q5 Which of the following best describes your role or perspective related to this topic of the survey? Select all that apply.

- ☐ Parent / guardian of a child (1)
 - ☐ School staff (e.g., teacher, principal, school nurse, facilities, maintenance, other school staff) (2)
 - ☐ Health / IAQ professional (e.g., clinician, public health, industrial hygienist) (3)
 - ☐ Policy maker (e.g., district, state/provincial, national) (4)
 - ☐ Building/ engineering/ HVAC professional (5)
 - ☐ Researcher / academic (6)
 - ☐ Community / advocacy organization representative (7)
 - ☐ Other (please specify): (8)
-

Q6 What is your gender?

- ☐ Female (1)
- ☐ Male (2)
- ☐ Non-binary (3)
- ☐ A gender not listed (4)
- ☐ I prefer not to answer (5)

Q7 How many children between **9 and 12 years old** do you have?

- ☐ 0 (1)
- ☐ 1 (2)
- ☐ 2 (3)
- ☐ More than 2 (4)

End of Block: Entry questions

Start of Block: Awareness and knowledge questions

Q8 Understanding indoor air quality The following questions ask how much you know and are aware of indoor air quality. The questions focus on young children (aged 9–12) at school, and specifically on the air quality indoors. How often do you think about children's exposure to indoor air pollution at school?

- ☐ Never (1)
 - ☐ Rarely (2)
 - ☐ Sometimes (3)
 - ☐ Often (4)
 - ☐ Always (5)
-



Q9 How concerned are you about indoor air quality in schools?

- Not at all concerned (1)
- Slightly concerned (2)
- Somewhat concerned (3)
- Moderately concerned (4)
- Extremely concerned (5)

Q10 How much impact do you think indoor air quality has on children?

- Negligible (1)
- Minor (2)
- Moderate (3)
- Major (4)
- Severe (5)

Q62 To what extent do you agree with the following statements? *When you are unable to judge, please opt 'Don't know'. (Likert scale: complete disagree, disagree, neither disagree nor agree, complete agree, do not know)*

- Schools are able to manage indoor air quality adequately (1)
- Schools provide sufficient information about indoor air quality to parents (2)
- Schools invest sufficient effort in raising children's awareness of indoor air quality (3)

End of Block: Awareness and knowledge questions

Start of Block: Background information

Q66 The next questions are about how schools manage the air indoors. To help you make an informed choice, we provide you with some basic information about how indoor air quality is regulated in Europe.

At the moment, there is no single European way of dealing with indoor air quality. Although there are few regulations, such as those that deal with the energy performance of buildings, each member state is responsible for monitoring and defining limit values for indoor environments. Rules about air quality in schools are mostly made and put in place by the local government or regional authorities. Some European countries have strict rules about indoor air quality, while others do not have any guidelines. Some good practices include: measuring CO₂ with sensors; having good ventilation and filtration systems, and carrying out risk assessments to determine what kind of pollutants might be present. Some schools also organise training for staff to make sure children have a healthy indoor environment.

End of Block: Background information

Start of Block: Ranking of dilemmas

Q18 Dilemmas In this part of the survey, you will be presented with different dilemmas related to indoor air quality management in schools. For each dilemma, please select the option you believe is the best solution or course of action. There are no right or wrong



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answers—we are interested in your honest opinion to help improve indoor air quality for children and school staff. **What is the best solution?** *Hover over the respective answer option for more information about the positive and negative points of each solution. Please allow a few seconds for it to load.*

- National indoor air quality guidelines and standards (1)
- Indoor air quality guidelines and standards for all EU member states (2)

Q15 If you like, please provide a reasoning for your answer:

Q16 **What is the best solution?** *Hover over the respective answer option for more information about the positive and negative points of each solution. Please allow a few seconds for it to load.*

- Mandatory norms and regulations that everyone has to comply with (1)
- Flexible guidelines to support the management of indoor air quality based on motivation (2)

Q17 If you like, please provide a reasoning for your answer:

Q14 **What is the best solution?** *Hover over the respective answer option for more information about the positive and negative points of each solution. Please allow a few seconds for it to load.*

- Simple and universal indoor air quality regulation (1)
- Targeted protection for vulnerable groups (2)

Q19 If you like, please provide a reasoning for your answer:

Q20 **What is the best solution?** *Hover over the respective answer option for more information about the positive and negative points of each solution. Please allow a few seconds for it to load.*

- Full automation of indoor air quality management through technologies (1)
- Human control and agency in indoor air quality management (2)

Q21 If you like, please provide a reasoning for your answer:

Q22 What is the best solution? *Hover over the respective answer option for more information about the positive and negative points of each solution. Please allow a few seconds for it to load.*

- Making schools and teachers responsible for indoor air quality management (1)
- Making local governments and agencies responsible for indoor air quality management plans in schools (2)

Q23 If you like, please provide a reasoning for your answer:

End of Block: Ranking of dilemmas

Start of Block: Prioritization of solutions

Q69 Prioritization of solutions What do you think should be the main action schools should do to improve the indoor air quality? *Please list your top three choices, with one being the most important.*

- _____ Monitor air quality (1)
- _____ Renovate or upgrade school buildings (2)
- _____ Teach children about air quality (3)

Q73 What do you think should be the main action schools should do to improve the indoor air quality? *Please list your top three choices, with one being the most important.*

- _____ Improve air ventilation (exchange indoor air with fresh outdoor air) (1)
- _____ Improve air filtration or purification (clean the existing indoor air) (2)
- _____ Improve air quality monitoring (measure the level of pollutants) (3)

End of Block: Prioritization of solutions

Start of Block: School professionals

Q75 Questions for school staff To what extent do you agree with the following statements? *When you are unable to judge, please opt 'Don't know'. (Likert scale: complete disagree, disagree, neither disagree nor agree, complete agree, do not know)*

- There is not enough information available for school staff to do anything about indoor air quality (1)
- Indoor air quality management places an extra burden on school staff (2)
- Indoor air quality is not an urgent topic anymore since the Covid-19 pandemic (3)
- There is not enough budget for the school to effectively manage indoor air quality (4)
- Ventilation systems are not well maintained in the school (5)
- My school has an effective indoor air quality management plan (6)

End of Block: School professionals



Start of Block: Child block

Q28 Questions for your child The next set of questions is for children. If you have more than one child aged between 9 and 12, only complete this section with one of them. Participation is voluntary. You may choose for your child not to participate. Your child may also decide not to participate in this study or withdraw from participating at any time. Would you like your child to take this survey now?

- ☐ Yes, I would like my child to take this survey now. (1)
- ☐ No, I would not like my child to take this survey. (2)

Skip To: End of Block If Q28 = No, I would not like my child to take this survey.

Q67 Questions for your child How old are you?

- ☐ 9 (1)
- ☐ 10 (2)
- ☐ 11 (3)
- ☐ 12 (4)

Q29 In general, how satisfied are you about the indoor air quality in the classroom? Sad face = bad indoor air quality Happy face = good indoor air quality



- 1 (1)**
- 2 (2)**
- 3 (3)**
- 4 (4)**
- 5 (5)**

Q30 How much do you feel that the air in your classroom affects how you feel or learn?

- ☒ A lot (1)
- ☐ A little (2)
- ☐ Not at all (3)
- ☐ I do not know (4)

Q67 Do you think your teacher or school are doing enough to keep the air in your classroom clean and healthy?

- ☐ Yes, they are doing a lot (1)
- ☐ They are doing some things (2)
- ☐ No, they are not doing enough (3)
- ☐ I do not know (4)

Q36 Questions for your child I want to learn more about healthy indoor air at school:

- ☐ Yes (1)
- ☐ No (2)
- ☐ I do not know (3)

Q37 I want to help my teacher to keep the air fresh in the classroom (for instance: open the window):

- ☐ Yes (1)
- ☐ No (2)
- ☐ I do not know (3)

Q38 I sometimes tell the teacher when the air in the room is bad:

- ☐ Yes (1)
- ☐ No (2)
- ☐ I do not know (3)

All questions are now completed. Please click next to submit your answers.



Annex IV – Informed consent template survey

PERSONAL DATA - INFORMED CONSENT FORM

We propose you to participate in scientific research.

You can stop your participation at any time (in writing), without giving a reason.

You will find more information about the research below. Do not hesitate to ask questions to the researcher if something is not clear.

1. Description of the research

- **Title:** LEARN – participatory policy making
- **Researchers:** Carina Veeckman, carina.veeckman@vub.be
- **Supervisor:** Leo Van Audenhove, Leo.Van.Audenhove@vub.be
- **Research group or department:** imec-SMIT, Vrije Universiteit Brussel
- **Purpose of the research:** Formulation of policy recommendations for improving indoor air quality management in school environments based on inputs from children, parents, school and maintenance staff and other experts
- **Practical conduct:** questionnaire (15 min. completion time), research period: January 2026 – March 2026

2. Responsible data controller

VUB (Vrije Universiteit Brussel), Pleinlaan 2, 1050 Brussels, company number 449.012.406.

3. Conditions to participate

Anyone can participate in the study without obligation; no prior knowledge is required.

In particular, we like to hear the opinions of children (9-12 years old), parents, school and maintenance staff. Experts in the field of indoor air quality management can also participate.

4. Description of risks and benefits

Your participation will not involve any risks.

You will gain access to scientific knowledge about indoor air quality and the opportunity to contribute to this by sharing your opinion. You will also contribute to better air quality policy at schools to protect children's health.

5. Confidentiality

We will keep the collected data confidential and respect the privacy legislation, including the European General Data Protection Regulation (GDPR).

6. Data – Purpose – Retention Time – Transfer



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For this research, we will collect the following personal data: country, number of children, age of your child (9-12 years old), gender, your opinion and (if applicable) your child's opinion on indoor air quality in school. We will only process your data for the purpose of scientific research. We will store your data for 10 years after the end of the research. Your data may be re-used for the purposes of scientific research in the general interest, under the condition that protection measures are taken.

7. Security

The storage of your data will offer a high degree of protection, in accordance with the guidelines of VUB (VUB Charter of the Researcher, ICT Security policy).

We will pseudonymize your data as soon as possible. We do not collect direct identifiers, and indirect identifiers will be aggregated (such as age bands). A number will be assigned to each participant.

VUB does not have access to the key linking codes to identities.

8. Your rights

You have the right to access, correct and erase your data, request information on the way we handle your data, request a copy of your data, limit the way we handle your data and ask us to transfer your data to third parties.

You are entitled to withdraw the consent to process your data at any time, without having to justify your request.

The exercise of your rights may be limited if this would seriously complicate our research. For example, if you withdraw your consent, we might continue to use the data we had collected before the withdrawal of your consent.

9. Contact

If you have questions or if you wish to exercise your rights, you can contact Carina Veeckman (carina.veeckman@vub.be) or the data protection officer of VUB (dpo@vub.be).

10. Complaints

If you wish to complain about the way we handle your data, you can contact the researchers, the supervisor or the DPO (cf. above).

Or you can file a complaint with the data protection authority:

Drukpersstraat 35, 1000 Brussel
Tel. +32 2 274 48 00
email: contact@apd-gba.be
website: www.dataprotectionauthority.be

11. Declaration of the researcher

The undersigned researchers confirm that the participant has received a copy of the present document and that they have answered all its possible questions.

Carina Veeckman (06/01/2026)



Annex V - Updates Phase 1

This chapter presents the updates of phase 1 of the PAR4P-method. Phase 1 focusses on the situational assessment with the quick scan analysis of directives and guidelines for indoor and outdoor air quality.

Air quality guidelines in Belgium

Previously identified in D8.2:

- **Decree of the Flemish government (14/01/2011) environmental legislation** (ambient air, risk communication by VMM)
- **Federal Indoor Environment Decree on IAQ** Federal government; platform indoor air quality - voluntary basis) (6/11/2022)
- **Code of practice: indoor air quality in workplaces (2019)**, connected to the Federal Act of August 4, 1996, on the well-being of employees in the performance of their work

Newly identified guidelines through the expert interviews:

- **Decree of the Flemish Government on measures to combat health risks caused by indoor environmental pollution** (citation: "the Indoor Environment Decree"). Anyone responsible for the construction, maintenance, or furnishing of residential or publicly accessible buildings shall take all necessary measures to minimize the health risks posed by the indoor environment to occupants or users. The Flemish Minister responsible for Health Policy, the Flemish Minister responsible for Housing, and the Flemish Minister responsible for the Environment are, each within their respective areas of responsibility, responsible for the implementation of this decree. The occupational health and environmental specialists at Logo's, as well as the competent authority, are authorized to conduct an investigation into potential health risks and health complaints related to the indoor environment. (Logo: a partnership recognized by the Flemish Government for local-regional health consultation and organization within a contiguous area)
- **Energieprestatie-regelgeving** (energy performance regulations) of the Flemish Government for school buildings, based on the **Energy Performance of Building Directives (EPBD) of the EU**.

Additional awareness raising materials, tools and checklists identified through the expert interviews:

- **Week van Gezond Binnen**: From November 24 through 28, the Department of Health is organizing Healthy Indoor Air Week. During this week, the Department of Health aims to raise awareness among professionals and the public about the importance of healthy indoor air and encourage them to take action.
- **Brochure and folders** about healthy indoor air in residential buildings by the Health Department of the Flemish Gov.
- **Checklist** for healthy indoor school environments
- **Inspiration Guide 'Healthy indoor air'**: working with vulnerable groups
- **Guidebook** about ventilation in school buildings
- **Technical fiches** about ventilation in school buildings



Air quality guidelines in Denmark

Previously identified in D8.2:

- **Executive order on air quality assessment and management BEK nr 1472 of 12/12/2017**
- **Limit values for hazardous substances and materials (2007)**
- **Executive Order on the Conditions at Permanent Places of Work**

Newly identified guidelines through the expert interviews:

- Building regulations for ventilation, and thermal indoor climate regulations for cool and heating : <https://www.bygningsreglementet.dk/>

Air quality guidelines in Greece

Previously identified in D8.2:

- Measures to improve ambient AQ based on the DIRECTIVE 2008/50/EC ([KYA HI 14122/549/E103, ΦΕΚ 488B/30.3.11](#))
- [Short-term action plans to combat particulate air pollution \(KYA 70601, ΦΕΚ 3272B/23.12.13\)](#)

Newly identified guidelines through the expert interviews:

- [EN 16798-1](#): Energy performance of buildings - Ventilation for buildings >> EN 16798-1 European standard for the design and assessment of energy performance in buildings
- Reduction of national emissions of certain atmospheric pollutants, transposition into national law Directive (EU) 2016/2284 of the European Parliament and of the Council (EEL 344/1/17.12.2016). Transposed via Law 4740/B/2018, aligning with EU-wide emission reduction commitments.
- [Presidential decree 338/2001](#): Protecting the health and safety of workers at work from risks due to chemical agents
- KENAK sets minimum requirements for the energy efficiency of buildings, including IAQ, ventilation rates, and thermal comfort.

Annex VI – Outreach of the polling campaign on LinkedIn

Dilemma 2 “Mandatory versus flexible guidelines based on motivation” (poll 1)

277 impressions	36 interactions	14 votes	13% interaction rate
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Option 1 ‘mandatory norms and regulation’: 93%

Option 2 ‘flexible guidelines based on motivation’: 7%

Dilemma 3 “Universal versus targeted protection of vulnerable groups” (poll 2)

218 impressions	21 interactions	11 votes	9,6% interaction rate
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Option 1 ‘simple and universal protection’: 45%

Option 2 ‘targeted protection for vulnerable groups’: 55%

Dilemma 4 “Full automation versus human control” (poll 3)

223 impressions	20 interactions	10 votes	8,9% interaction rate
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Option 1 ‘Automation through technologies’: 60%

Option 2 ‘Human control and agency’: 40%



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