



## **skoleklima.dk – A platform to monitor air quality and thermal comfort in classrooms, developed for teachers and students**

**Cali, Davide; Bachalarz, Magnus; Bacher, Peder; Madsen, Henrik; Lex, Simon Westergaard; Koed Rasmussen, Morten**

*Published in:*

Book of Abstracts, Sustain 2017

*Publication date:*

2017

*Document Version*

Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*

Cali, D., Bachalarz, M., Bacher, P., Madsen, H., Lex, S. W., & Koed Rasmussen, M. (2017). skoleklima.dk – A platform to monitor air quality and thermal comfort in classrooms, developed for teachers and students. In Book of Abstracts, Sustain 2017 [S-4] Technical University of Denmark (DTU).

## **DTU Library**

Technical Information Center of Denmark

---

### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

## skoleklima.dk – A platform to monitor air quality and thermal comfort in classrooms, developed for teachers and students

Davide Cali<sup>1</sup>, Magnus Bachalarz<sup>1</sup>, Peder Bacher<sup>1</sup>, Henrik Madsen<sup>1</sup>, Simon Westergaard Lex<sup>2</sup>, Morten Koed Rasmussen<sup>3</sup>

1: DTU Compute, 2 University of Copenhagen, 3 Høje Taastrup Kommune - \*Cor. author email: [dcal@dtu.dk](mailto:dcal@dtu.dk)

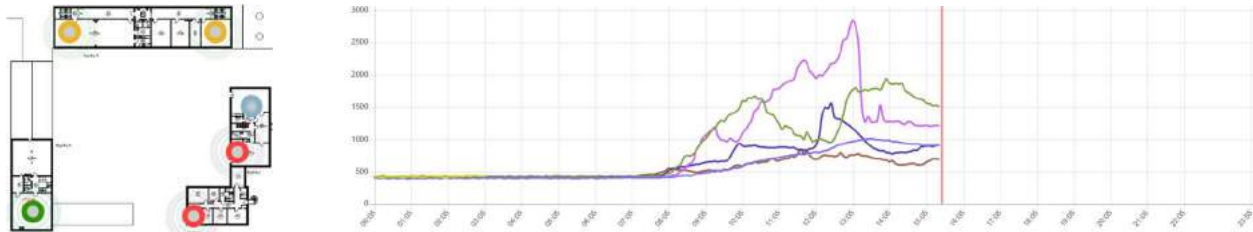


Figure 1 Qualitative evaluation of the CO<sub>2</sub> concentration (left) in some classrooms of a school, and related time series visualization (right) for a working day, from the skoleklima.dk platform.

Smart devices help us solving many complex tasks in an optimal way. In homes for instance, they can run our heating, ventilation and air conditioning systems (HVAC). Within the Smart Cities Accelerator project, among other goals, we aim to apply simple and cost effective smart solutions to get the best reachable indoor climate and thermal comfort at lowest energy cost, in real schools (located around the greater Copenhagen area, and the municipalities of Malmö and Lund in Sweden). Indoor air quality and thermal comfort are essential for a salubrious working and learning environment. We all well know that good thermal comfort conditions and a proper ventilation of the indoor environment lead to less sick leaves. Furthermore, we also know that a poor ventilated classroom exposes both teachers and scholars to high concentrations of volatile organic compounds (VOC) and CO<sub>2</sub>. Some VOC can have both short and long terms effects on our health, hence their presence in the air should be minimize. Moreover, levels of CO<sub>2</sub> concentration above 1000 ppm negatively affect the performance of both scholars and teachers.

Over 100 classrooms located in three different schools of the Høje Taastrup Municipality have been equipped with wireless sensors. At time of writing, we collect air temperature, air relative humidity, noise level and CO<sub>2</sub> concentration at 5 minutes intervals. The air temperature and the relative humidity help us evaluating the thermal comfort in each classroom. Moreover, since only human beings (and eventually plants) emit CO<sub>2</sub> in classrooms, monitoring the CO<sub>2</sub> concentration allow us to estimate the air exchange rate of the room. We hence gain fundamental information about how to run optimally the HVAC system. Within the project, we will increase the number of sensors (including also heat meters) and add smart actuators (e.g. thermostatic valves) to get a better control over the HVAC, hence over the indoor climate and over the energy use. The platform skoleklima.dk offers scholars and teachers the opportunity to visualize own classrooms' data, and get a key for a qualitative interpretation of those measurements. We also provide them advices on how to address problems (e.g. when and how to optimally ventilate). In addition, through skoleklima.dk, scholars can run experiments to understand the physics behind the HVAC system and the indoor climate. Furthermore, skoleklima.dk offers the possibility to exchange information related to the indoor climate and the HVAC system between teachers, and between teachers and buildings' managers.