A healthy learning environment thanks to climate innovation

A healthy learning climate is one of the main priorities of Onderwijsstichting Arcade, a large education foundation. The foundation, which aims to provide "good education for every child", operates 26 public primary schools in the municipalities of Coevorden and Hardenberg. Arcade's schools are intended to be places where children can get the best out of themselves. With that in mind, Gerjo Stegeman, the former director of public primary school Burgemeester Wessels Boerschool (BWB school) in Dalen (one of Arcade's schools), was immediately interested when Remko Meijerink from Sensor Development International (SDI) arranged an appointment with him in mid-2019. Remko wanted to know whether the foundation would be interested in testing his sensors at a number of the primary schools as part of a pilot project. A project that would focus specifically on sensors for improving the indoor climate in the classrooms. Remko had a vested interest because his children already attended Burgemeester Wessels Boerschool, which is just a stone's throw away from his company. SDI is an organisation that works all over the world for large international corporations such as Deutsche Telecom, T-Mobile and Microsoft. In spite of its international connections, the company has a policy of testing new and innovative products much closer to home.

Improved indoor climate and sustainability

Gerjo saw some potential and asked the opinion of a colleague, Roelof From, who was responsible for accommodation policy. Roelof's initial reaction was promising: "The sensors look like they could be a source of very useful information during the refurbishment and renovation work that we are about to start at BWB. They can also help us manage the sustainability of our buildings. Furthermore, we can use them to give our teachers advice about improving the indoor climate in the classrooms. By opening a window a little more often, for example", Roelof concluded. So there were good reasons for taking the idea of a collaboration between Arcade and SDI to the next stage.

Security and privacy

A good indoor climate in school buildings is important to ensuring the well-being of the children and the teaching staff. Various factors come into play here, such as the temperature, humidity and the CO2 percentage in the air. As the director of the school, with a duty to protect privacy, Gerjo had some initial misgivings about using sensors in his school, mainly because he wanted to know exactly what the data would be used for. He did not want the data generated by the sensors to end up in the wrong place. The school had to be a safe and secure place in all respects, so data leaks and breaches needed to be avoided at all costs. SDI's system uses Narrowband IoT (NB IoT) within the 4G/5G mobile phone network. This is the latest communication technology for sensors. It is known for its speed and security. Once Gerjo's fears had been allayed, Arcade and SDI decided to work together.

Concentration and performance

In the first instance, sensors that measure the carbon dioxide in the air (CO2 percentage) were installed in the school. In recent years, CO2 in the air we breathe has been increasingly recognised as a parameter that plays a key role in the quality of indoor climates. This is because research has shown that the CO2 level is a good measure of the degree of ventilation in a room. Good ventilation is very important, particularly in buildings and spaces where many people come together, such as schools. However, the air quality in these buildings is often substandard. A high level of CO2 can have an adverse effect on performance and lead to impaired concentration. The school obviously wants the best for the children, so it agreed to deploy the sensors for this worthwhile application. This was just before the coronavirus outbreak. Then the COVID-19 crisis started. A period that quickly led to the conclusion that there was a strong link between air quality and virus spread.

Coronavirus challenges

In order to analyse whether ventilation systems in schools were safe enough and virus-proof, Minister Slob formed the national 'ventilation in schools' task force (Landelijke Coördinatieteam Ventilatie op Scholen/ LCVS) in mid-March 2020. Each school was asked to indicate the extent to which the buildings complied with the Dutch Buildings Decree in order to come to a conclusion about ventilation quality. Roelof had his doubts about this approach. "The Buildings Decree is not a good indicator of adequate ventilation, particularly in the case of older buildings", he says. And Remko Meijerink at SDI agreed: the Buildings Decree was never intended to be used as a yardstick for the quality of ventilation systems. The current Buildings Decree came into effect in 2012 and is based on recommendations drawn up by the Dutch Health Council in 1984. According to experts, the decree does not aim to prevent the spread of infectious diseases such as COVID-19. Onderwijsstichting Arcade also concluded that the link between the Buildings Decree and ventilation systems was not particularly strong. Because the foundation is very progressive in its approach, it decided to tackle this issue from a different perspective. Furthermore, the foundation and SDI realised that they were already halfway to dealing effectively with this problem.

Aerosols and ventilation

The sensors that the foundation was now using in the buildings had been upgraded by SDI to measure a range of values, including CO2, temperature, humidity and the presence of persons. This marked the birth of the CO2 monitor. Thanks to this monitor, the CO2 concentration in a room can be taken as a measure to indicate correct ventilation. It gives the school clear data and also generates alerts when action is required. But what is the right response and how do you ventilate correctly? What should you do and what should you avoid doing? The latter question is even more important now that winter is imminent.

Wearing coats in the classroom

During the summer months, the strategy was clear: open as many windows and doors as possible. But now that winter was coming, the schools were worried about what would happen next when the temperatures outside dropped even further. Pupils were already wearing shirts with long sleeves and keeping their coats on in the classroom. The 26 schools operated by Arcade also include older buildings where natural ventilation is the only option. Installing ventilation systems in those buildings in the short term would be both time-consuming and lead to a huge outflow of cash. So the windows had to be kept open as much as possible. The right strategy for good ventilation depends on the room itself, the surface area and the number of people using the room. So issuing clear and unambiguous advice for all situations is difficult. Even so, Roelof, who is responsible for building management, wanted to find a way of giving sensible advice to the building users, particularly the teachers. In other words, it would be useful if teachers had at least some idea of the air quality in the classroom so that they could take action in good time.

Monitoring air quality with the App

With that in mind, Sensor Development International started work to build an application that would retrieve the data from the CO2 monitor, display it in real time for teachers and recommend appropriate action. Each room is equipped with a sensor, which is linked to a QR code. The teacher only needs to connect his smartphone to Sensor Development's app via the QR code to see what the situation is and view recommended actions. Those actions vary from opening windows more often, or for longer, to more drastic measures such as reducing the number of people allowed into a space or classroom. This is because the CO2 values in a room rise as the number of people increases. If a teach-er cannot bring the CO2 values down to the right level by ventilating, it is clear that the maximum number of people in the room has been exceeded. The App combines the readings generated by the CO2 sensor with the values recorded by the sensor for counting people to make a recommendation regarding the maximum number of people that should be allowed in a particular room.

Innovating together

The users expressed a desire to view multiple sensors at the same time and also be able to review historical data for several days. All developments and features that SDI has made available. SDI is also looking at adding push messages to the App. Thanks to this feature, teachers automatically receive a message when the values are too high and do not have to continuously monitor the App. This collaboration illustrates how an international player with local roots can help a regional education foundation with ambitious ideas.