UKRAINE TEAM

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MONITORING OF THE MICROCLIMATE IN THE CLASSROOMS OF EDUCATIONAL INSTITUTIONS USING MODERN DIGITAL LABORATORIES

INTRODUCTION

Optimal microclimate is one of the necessary conditions for normal life and well-being of people. That is especially important during the coronavirus disease pandemic.

Effective control of microclimate parameters in educational premises improves work capacity and health of students (or employees at work), due to observing all sanitary standards in classrooms.

The relationship with the global goals of the UN: “good health and well-being”, “quality education”, “clean water and sanitation”.

Used methodology: elementary-theoretical analysis, experiment, measurement, observation, comparison, empirical analysis, inductive reasoning.

Fig. 1. Einstein Tablet+2 digital laboratory

TASKS

- to justify the importance of microclimate monitoring in educational institutions;
- using the Einstein Tablet+2 digital laboratory (see Fig. 1), to conduct monitoring of microclimate in the classrooms of my school and compare results with standards;
- to show the expediency of using digital laboratories for research purposes;
- to propose existing methods of improvement of microclimatic conditions;
- to invent a system that may be useful and the most expedient for the goal of continuous microclimate control and improvement in an educational institution.

HYPOTHESIS

One day I realized that the daily sleepiness, fatigue, and feeling bad at school had a reason. Then I started my research. The more literature I read, the more I was inclined to think that the reason for this is bad microclimatic conditions. And if it is so, probably this problem exists in other educational institutions.

Classroom №	Temperature (°C)	Humidity (%)	(lx)		Floor area (m²)	windows in the classroom (m²)	LF
			natural	mixed			
6	14,4	57,8	290	476	44,84	7,8	0,174
7	15	55,8	270	524	27,36	5,2	0,190
8	15,4	64,2	110	420	48,38	7,8	0,161
9	16,6	59,8	150	440	47,2	7,8	0,165
10	18,4	61,8	236	588	28,5	4,3	0,151
Lib	18	58	224	790	43,2	7,8	0,18
15	17,8	61,7	406	626	47,4	7,8	0,160
18	18	58,4	340	474	84,6	7,8	0,160
19	16,5	62	195	430	47,4	7,8	0,164
20	16,7	48,3	342	522	46,1	7,8	0,169
21	18	59,3	295	512	46,1	7,8	0,169
22	17	55,9	408	564	45,6	7,8	0,171
23	18,1	64	570	706	38,5	7,8	0,202
24	19	55,7	1340	1662	38,35	7,8	0,202

Table 1. (values which fall within the normative interval are green, and which did not fall are red)

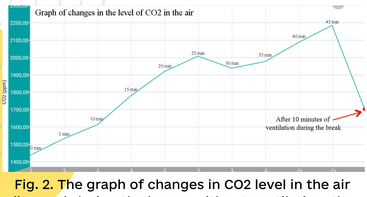

Fig. 2. The graph of changes in CO2 level in the air (in ppm) during the lesson without ventilation; the last point of graph is the value of CO2 level after the 10 minute break

RESEARCH PROCESS

I have monitored the microclimate of my lyceum using Einstein Tablet+2. I recorded the results in Table 1 and compared them with the normative values from the sanitary regulations. In addition, I conducted measurements of CO2 and relative humidity during the lesson. After the second lesson in a row, the level of CO2 exceeded the normative values by 2 times. Moreover, ventilation during the 10-minute break is not effective enough to restore the CO2 level to normal (see Fig. 2), but effective for drying the room air (see Fig. 3).

As you can see, educational institutions need means to improve microclimatic conditions. And, taking into account the fact that the values of all the studied parameters depend on many external factors it seems appropriate to conduct continuous monitoring of these parameters.

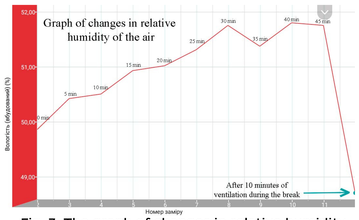

Fig. 3. The graph of changes in relative humidity of the air (in %) during the lesson without ventilation; the last point of graph is the value of relative humidity after the 10 minute break

SOLUTION

That is why I set myself the goal of creating such a system, which in real-time during the working day will be able to receive the values of the microclimate parameters in each room of a building and automatically normalize them using unique devices.

This system will be able to normalize temperature, humidity, CO2 level, and illumination; and filter dust, bacteria, and generally PM2.5 particles. In addition, the panel of sensors will transmit received data via Wi-Fi to the main computer. There, the data will be entered into a database and processed. I called this system “The system of centralized control and automatic improvement of microclimate”, abbreviated as SCCAIM (see Fig. 4).

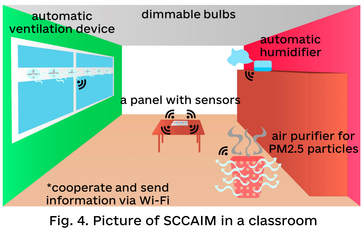

Fig. 4. Picture of SCCAIM in a classroom

CONCLUSIONS

I experimentally made sure that the microclimate of my lyceum is not ideal (this could mean that some part of other educational institutions more or less has the same problem). It needs to improve its control system and needs to take measures for improvement.

In addition, in the full-report, I investigated in detail the possible consequences of the violation of microclimate standards. Besides SCCAIM, I have suggested other microclimate improvement devices, but most of them can be quite expensive to install in a school. It will be even more expensive to assemble the entire set of devices for controlling all the main parameters of the microclimate.

So going forward I plan to develop the SCCAIM idea and create a prototype. Then conduct monitoring with it for practical proof of the appropriateness and effectiveness of its use.

If educational institutions take care of microclimatic conditions, they will achieve a significant increase in working capacity and student attendance, thanks to a decrease in incidence. This will clearly increase the number and quality of skilled workers in the entire world.