



SEASONAL THERMAL CONDITIONS AND COLD SEASON VENTILATION INDICATORS IN PRIMARY SCHOOL CLASSROOMS IN TASHKENT

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Abstract

Background: Classroom conditions are also the daily working environment of primary school teachers. Seasonal temperature variation and insufficient outdoor air supply require assessment together because improving one condition may worsen the other.

Objective: To describe classroom temperature patterns and cold season carbon dioxide concentrations in schools in two districts of Tashkent.

Methods: This descriptive analysis used environmental measurements reported in Nigmatullayeva's 2025 dissertation. The environmental assessment was conducted during the 2021–2022 academic year within a broader research programme. Aggregate results for four floor levels in Olmazor and Mirzo Ulugbek districts were extracted without reconstructing individual measurements.

Results: Classroom temperatures ranged from 12.7 to 17.3 °C in winter–spring and from 27.9 to 30.4 °C in summer–autumn. Cold season classroom carbon dioxide concentrations ranged from 1169.0 to 2296.83 ppm; all eight district by floor summary values exceeded the 1000 ppm reference used in the dissertation.

Conclusions: The reported measurements identify a combined need for thermal control and ventilation assessment. They do not establish a causal relationship with teacher illness or performance.

Keywords: Primary school; occupational hygiene; classroom microclimate; carbon dioxide; ventilation; Tashkent.



Introduction

Primary school classrooms serve simultaneously as learning spaces and teachers' workplaces. Teachers remain in occupied rooms for successive lessons, supervise children and carry out tasks that demand sustained communication and attention. Environmental assessment should therefore consider the conditions experienced by both groups rather than treating school hygiene solely as a child health issue. Thermal conditions and outdoor air supply are interconnected. Opening windows may improve air exchange but reduce room temperature during cold weather. In warmer weather, window opening may provide limited thermal relief, particularly where outdoor conditions are hot. An effective school environmental programme must balance these competing demands.

Carbon dioxide measurement can support ventilation assessment, but its interpretation depends on occupancy, outdoor concentration, sensor location and air mixing. CDC guidance cautions against applying a single concentration target to every room and occupancy pattern [2]. In this article, the 1000 ppm value is retained as the dissertation's operational reference rather than presented as a universal toxicity threshold.

The objective was to describe seasonal classroom temperature patterns and cold season carbon dioxide summary values in two Tashkent districts and identify practical priorities for further environmental control. The analysis focuses on exposure characterization; teacher health outcomes were not linked to individual classroom measurements.

Materials and methods

Study design and setting. This article presents a descriptive secondary analysis of environmental results from the dissertation Hygienic assessment of the health and working conditions of primary school teachers in general education schools and ways to optimize them [1]. The broader programme included schools in Olmazor and Mirzo Ulugbek districts. The methods chapter places the workplace environmental assessment in the 2021–2022 academic year.

Measurements. The dissertation describes use of a thermo-hygro carbon dioxide meter for temperature, relative humidity and carbon dioxide assessment. Its



protocol refers to repeated measurements at specified room heights and positions away from surrounding surfaces. Temperature results were grouped as winter–spring and summer–autumn. Classroom results were reported separately for the first through fourth floors; library and sports hall values were not pooled with classroom observations.

Data extraction and analysis. Temperature means and cold season carbon dioxide means were extracted from source tables 4.1 and 4.3. These values represent district by floor summaries, not eight independent schools or eight individual measurements. Ranges and ratios to the source reference were calculated descriptively. No statistical tests, confidence intervals or exposure response estimates were generated because measurement counts and raw observations were unavailable.

Data quality. The original tables express values as $M \pm m$. The present article reports means only because the sampling structure needed to interpret uncertainty is insufficiently documented. Several warm season carbon dioxide values in the source are unusually low for occupied indoor spaces and lack outdoor reference measurements; they were excluded from quantitative ventilation interpretation pending verification. Environmental measurements presented here contain no personal identifiers.

Results

Table 1 Seasonal classroom temperature means in degrees Celsius

Floor	Olmazor cold	Olmazor warm	Mirzo Ulugbek cold	Mirzo Ulugbek warm
First	15.1	30.1	14.4	27.9
Second	16.0	29.7	17.3	29.7
Third	15.9	30.4	13.3	29.2
Fourth	12.7	29.8	14.3	28.4

Cold season classroom means were below 18 °C at every reported floor level in both districts. The lowest value was 12.7 °C on the fourth floor in Olmazor; the highest cold season mean was 17.3 °C on the second floor in Mirzo Ulugbek. Warm season values were consistently higher, ranging from 27.9 to 30.4 °C.



These are seasonal grouped means and should not be interpreted as minimum or maximum daily exposures.

Table 2 Cold season classroom carbon dioxide means in ppm

Floor	Olmazor	Mirzo Ulugbek
First	1839.4	1552.5
Second	1792.7	2296.83
Third	1169.0	2169.0
Fourth	1259.5	2259.5

All eight classroom summary means were above the source's 1000 ppm reference. Values ranged from 1.17 to 2.30 times that reference. In Olmazor, the first and second floors had higher means than the third and fourth floors. Mirzo Ulugbek showed its highest mean on the second floor. This variation supports room specific assessment rather than reliance on one district average.

The coexistence of low cold season temperature means and elevated carbon dioxide summaries indicates that acceptable heating and outdoor air supply were not consistently achieved in the reported settings. The aggregate data do not show whether temperature and carbon dioxide were measured simultaneously in the same occupied rooms.

Discussion

The findings identify two practical environmental management problems: inadequate cold season thermal conditions and high carbon dioxide relative to the source reference. Closing windows to conserve heat is a plausible explanation for insufficient air exchange, but window opening behaviour and ventilation flow were not quantified. The observed pattern therefore supports investigation of that mechanism rather than a confirmed explanation.

Carbon dioxide should be used as an indicator within a broader assessment. Concentration alone cannot determine air change rate without additional information about occupancy, room volume, outdoor concentration and carbon



dioxide generation. It also does not quantify particulate matter or establish infectious aerosol exposure. CDC ventilation guidance supports assessment of building systems and multiple complementary measures [2,3].

The warm season temperature results support inspection of shading, solar heat gain and thermal control. A cooling unit should not automatically be assumed to deliver outdoor air; its ventilation function requires separate assessment. Likewise, increasing window opening is not an adequate standalone solution where it produces excessive cold or introduces outdoor pollution.

A practical response would begin with checks of heating distribution and ventilation pathways, followed by occupied room monitoring across successive lessons. Temperature, relative humidity and carbon dioxide should be recorded together with pupil number, lesson timing and window status. Any control measure should then be assessed with repeat measurements under comparable occupancy.

Limitations include aggregate reporting, uncertain measurement counts, incomplete sensor calibration documentation and the absence of paired outdoor carbon dioxide measurements. Floor group summaries may conceal variation among schools and rooms. The data cannot estimate the proportion of teachers exposed above a threshold, nor do they support health risk ratios or claims that ventilation improvements have already reduced morbidity.

Conclusion

Reported classroom means demonstrated low winter–spring temperatures and substantially higher summer–autumn temperatures. Cold season carbon dioxide means exceeded the dissertation’s operational reference at all reported classroom floor levels. School environmental management should assess thermal control and outdoor air supply together, with room specific monitoring and verification of measurement quality.



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