Table 1. Screening Results of Thermal Comfort Indicators With Pass–Fail Classification and Justification

Thermal Comfort Indicator	M	R	Rel	DA	U	LTA	Total	Screening Result	Justification
Temperature (general)	0	1	0	1	1	1	4	Failed	Broad conceptual term without standardized measurement protocol; overlaps multiple thermal variables
Thermal conditions	0	1	0	1	1	1	4	Failed	Vague descriptor lacking defined scale and operational definition
Relative humidity	2	2	2	2	2	2	12	Passed	Standardized parameter with clear measurement protocol defined in ASHRAE 55 and ISO 7726
Air temperature	2	2	2	2	2	2	12	Passed*	Redundant with dry-bulb temperature; consolidated under standardized terminology
Mean radiant temperature	2	2	2	2	2	2	12	Passed	Core thermal comfort variable defined in ISO 7726 and required for PMV calculation
Indoor temperature	1	2	1	2	2	2	10	Passed*	Conceptually equivalent to air temperature; no additional analytical value
Outdoor temperature	2	0	2	2	2	2	10	Passed*	But represents external climatic context rather than indoor occupant exposure
Mean temperature	0	1	0	1	1	1	4	Failed	Non-standard indicator not formally defined in major thermal comfort standards
Operative temperature	2	2	2	2	2	2	12	Passed	Integrative comfort indicator combining air and radiant temperature; standardized in ASHRAE 55
Dry-bulb temperature	2	2	2	2	2	2	12	Passed	Primary indoor thermal variable with direct, repeatable field measurement
Globe temperature	1	1	1	1	1	1	6	Failed	Intermediate parameter used only to derive mean radiant temperature
Heating and cooling loads	0	1	0	0	1	1	3	Failed	Energy-performance metric requiring simulation; not an occupant comfort indicator
Turning heaters on/off	0	1	0	1	1	1	4	Failed	Behavioral response lacking quantitative scale and unsuitable for longitudinal assessment
Surface temperature	1	1	1	1	1	1	6	Failed	High spatial variability and limited feasibility for consistent monitoring
Clothing insulation	2	2	2	2	2	2	12	Passed	Standardized personal parameter expressed in clo units (ISO 9920)
Metabolic rate	2	2	2	2	2	2	12	Passed	Standardized physiological parameter expressed in met units (ISO 8996)
Thermal sensation	2	2	2	2	2	2	12	Passed	Direct subjective comfort response measured using standardized ASHRAE 7-point scale
Mechanical cooling/heating system	2	2	2	2	2	2	12	Passed	Operational system status directly influences indoor thermal exposure
Insulation	1	1	1	1	1	1	6	Failed	Envelope characteristic not directly measurable through non-invasive field monitoring
PMV (Predicted Mean Vote)	2	2	2	2	2	2	12	Passed	Internationally accepted composite thermal comfort index (ISO 7730)
Predicted Percentage of Dissatisfied (PPD)	2	2	2	2	2	2	12	Passed	Quantitative comfort dissatisfaction metric directly derived from PMV

Note:
M – Measurability; R – Relevance; Rel – Reliability; DA – Data Accessibility; U – Understandability; LTA – Long-term Applicability; Total – Total Score.
Scores were assigned using a 0–2 ordinal scale (0 = not satisfied, 1 = partially satisfied, 2 = fully satisfied), with a maximum total score of 12.

Classification is based on total score: Passed (10–12), Borderline (7–9), and Failed (0–6).
Passed * - Passed indicates indicators that satisfied the screening criteria but were excluded from the final indicator set due to redundancy, conceptual overlap, or consolidation under standardized terminology. Justifications for exclusion are provided in the table.

Table 2. Screening Results of Indoor Air Quality Indicators With Pass–Fail **Classification and Justification**

Indoor Air Quality Indicator	M	R	Rel	DA	U	LTA	Total	Screening Result	Justification
Ventilation rate	2	2	2	2	2	2	12	Passed	Quantifiable parameter with standardized measurement methods (L/s·person or ACH)
Air quality (general)	0	1	0	1	1	1	4	Failed	Broad conceptual term lacking defined measurement scale
Carbon dioxide levels/concentrations	2	2	2	2	2	2	12	Passed	Widely accepted proxy for ventilation adequacy with established thresholds
Settled dust	1	1	0	1	1	1	5	Failed	Highly variable; lacks standardized sampling and exposure thresholds
Total volatile organic compounds (TVOCs)	2	2	2	2	2	2	12	Passed	Standard aggregate indicator of chemical pollutants measurable via sensors
Particulate matter concentrations	2	2	2	2	2	2	12	Passed	Core IAQ parameter ($PM_{2.5}$, PM_{10}) with established health guidelines
Indoor air pollutants (CO_2, PM, VOCs)	1	1	1	1	1	1	6	Failed	Composite descriptor duplicating individual pollutant indicators
Ozone (O_3)	2	2	2	2	2	2	12	Passed	Recognized indoor pollutant with measurable concentration limits
Carbon monoxide particle	2	2	2	2	2	2	12	Passed	Critical combustion-related contaminant with standardized exposure limits
Air velocity	2	2	2	2	2	2	12	Passed	Directly measurable airflow parameter influencing ventilation effectiveness
Air flow	1	1	1	1	1	1	6	Failed	Redundant with air velocity and ventilation rate
Pollutants ($PM_{0.5}$, PM_1, $PM_{2.5}$, PM_5, PM_{10}, TPM, UFP, CO, CO_2, VOCs)	1	1	1	1	1	1	6	Failed	Excessively disaggregated; consolidated under core pollutant categories
Radon	2	2	2	2	2	2	12	Passed	High-risk indoor pollutant with established international guidelines
Formaldehyde	1	1	1	1	1	1	6	Failed	Subsumed under VOC and TVOC classifications
Opening/closing windows	0	1	0	1	1	1	4	Failed	Occupant behavior variable lacking quantitative measurement scale
Perceptions of freshness/stuffiness/odors	1	1	1	1	1	1	6	Failed	Subjective perception indicator without standardized exposure scale
HVAC system	2	2	2	2	2	2	12	Passed	Operational system presence directly influences ventilation and filtration
Nitrogen dioxide (NO_2)	1	1	1	1	1	1	6	Failed	Included under core pollutant category consolidation
Freshness	1	1	1	1	1	1	6	Failed	Subjective descriptor overlapping odor perception

Smell/odors	1	1	1	1	1	1	6	Failed	Subjective indicator unsuitable for longitudinal quantitative analysis
Benzene	1	1	1	1	1	1	6	Failed	Individual VOC consolidated under TVOC indicator
Toluene	1	1	1	1	1	1	6	Failed	Individual VOC consolidated under TVOC indicator
Ethylbenzene	1	1	1	1	1	1	6	Failed	Individual VOC consolidated under TVOC indicator
Xylenes	1	1	1	1	1	1	6	Failed	Individual VOC consolidated under TVOC indicator
Amount of fresh air	2	2	2	2	2	2	12	Passed	Operational ventilation indicator reflecting outdoor air supply
Natural ventilation	1	1	1	1	1	1	6	Failed	Ventilation strategy descriptor, not an exposure indicator
Mechanical ventilation	1	1	1	1	1	1	6	Failed	System classification consolidated under HVAC system

Note:
M – Measurability; R – Relevance; Rel – Reliability; DA – Data Accessibility; U – Understandability; LTA – Long-term Applicability; Total – Total Score.
Scores were assigned using a 0–2 ordinal scale (0 = not satisfied, 1 = partially satisfied, 2 = fully satisfied), with a maximum total score of 12.
Classification is based on total score: Passed (10–12), Borderline (7–9), and Failed (0–6).

Table 3. Screening Results of Acoustic Indicators With Pass–Fail Classification and Justification

Acoustic Quality Indicator	M	R	Rel	DA	U	LTA	Total	Screening Result	Justification
Noise levels / background noise level	2	2	2	2	2	2	12	Passed	Fundamental classroom acoustic indicator representing ambient noise conditions
Sound level / sound pressure level	1	1	1	1	1	1	6	Failed	Retained using standardized metric T30 for consistency
Background noise	1	1	1	1	1	1	6	Failed	Broad qualitative descriptor lacking quantitative definition
Reverberation time	2	2	2	2	2	2	12	Failed	Retained under standardized Speech Transmission Index (STI)
Acoustic condition	0	1	0	1	1	1	4	Failed	Qualitative descriptor lacking standardized field measurement protocol
Speech intelligibility / clarity	1	2	1	1	1	1	7	Failed	Consolidated under LAeq as standardized descriptor
Apparent sound transmission	0	1	0	1	1	1	4	Passed	Internationally recognized equivalent continuous sound level metric
A-weighted sound pressure level	2	2	2	2	2	2	12	Passed*	Standardized reverberation time metric defined in ISO 3382. Consolidated under LAeq
LAeq	2	2	2	2	2	2	12	Passed	Objective speech intelligibility indicator standardized under IEC 60268-16
T30	2	2	2	2	2	2	12	Passed	Fundamental classroom acoustic indicator representing ambient noise conditions
STI	2	2	2	2	2	2	12	Failed	Retained using standardized metric T30 for consistency

Note:
M – Measurability; R – Relevance; Rel – Reliability; DA – Data Accessibility; U – Understandability; LTA – Long-term Applicability; Total – Total Score.
Scores were assigned using a 0–2 ordinal scale (0 = not satisfied, 1 = partially satisfied, 2 = fully satisfied), with a maximum total score of 12.
Classification is based on total score: Passed (10–12), Borderline (7–9), and Failed (0–6).

Passed * - Passed indicates indicators that satisfied the screening criteria but were excluded from the final indicator set due to redundancy, conceptual overlap, or consolidation under standardized terminology. Justifications for exclusion are provided in the table.

Table 4. Screening Results of Visual Comfort Indicators With Pass–Fail Classification and Justification

Visual Comfort Indicator	M	R	Rel	DA	U	LTA	Total	Screening Result	Justification
Visual comfort (general)	0	1	0	1	1	1	4	Failed	Broad conceptual construct lacking defined quantitative measurement scale
Illuminance levels	2	2	2	2	2	2	12	Passed	Core visual comfort parameter measured in lux with standardized thresholds
Lux level	2	2	2	2	2	2	12	Passed*	Redundant terminology consolidated under illuminance levels
Light intensity	1	1	1	1	1	1	6	Failed	Non-standard term overlapping illuminance definition
Daylight factor / daylight	2	2	2	2	2	2	12	Passed	Standard indicator for daylight availability in indoor spaces
Light conditions	0	1	0	1	1	1	4	Failed	Qualitative descriptor without operational definition
Light level	1	1	1	1	1	1	6	Failed	Conceptually redundant with illuminance
Illuminance uniformity	2	2	2	2	2	2	12	Passed	Standard indicator describing spatial distribution of lighting

Turning lights on/off, adjusting blinds or shades	0	1	0	1	1	1	4	Failed	Occupant behavior variable not representing visual exposure
Lighting capacity	1	1	1	1	1	1	6	Failed	Fixture design attribute rather than visual comfort outcome
Glare	2	2	2	2	2	2	12	Passed	Critical visual discomfort parameter with standardized assessment methods
Access to natural light / natural lighting	2	2	2	2	2	2	12	Passed	Key daylight availability indicator affecting comfort and well-being
Colour and attractiveness	0	1	0	1	1	1	4	Failed	Subjective aesthetic perception lacking standardized scale
Artificial lighting	2	2	2	2	2	2	12	Passed	Measurable lighting source condition affecting visual environment
Color temperature	2	2	2	2	2	2	12	Passed	Objective spectral lighting parameter measured in Kelvin

Note:
M – Measurability; R – Relevance; Rel – Reliability; DA – Data Accessibility; U – Understandability; LTA – Long-term Applicability; Total – Total Score.
Scores were assigned using a 0–2 ordinal scale (0 = not satisfied, 1 = partially satisfied, 2 = fully satisfied), with a maximum total score of 12.
Classification is based on total score: Passed (10–12), Borderline (7–9), and Failed (0–6).
Passed * - Passed indicates indicators that satisfied the screening criteria but were excluded from the final indicator set due to redundancy, conceptual overlap, or consolidation under standardized terminology. Justifications for exclusion are provided in the table.

Table 5. Screening Results of Environmental Quality Indicators With Pass–Fail Classification and Justification

Environmental Quality Indicator	M	R	Rel	DA	U	LTA	Total	Screening Result	Justification
Cleanliness	2	2	2	2	2	2	12	Passed	Directly observable environmental hygiene indicator with clear assessment criteria

Surface biocontamination	1	1	1	1	1	1	6	Failed	Consolidated under moisture and mold indicators
View conditions	2	2	2	2	2	2	12	Passed	Standard environmental quality indicator affecting well-being and cognitive performance
Defective building elements	1	1	1	1	1	1	6	Failed	Building condition descriptor without standardized quantitative scale
Moisture and mold	2	2	2	2	2	2	12	Passed	Critical indoor environmental health indicator with established assessment methods
Landscaping	1	2	1	1	1	1	7	Passed	Environmental amenity indicator influencing perceived environmental quality
Electricity consumption	2	2	2	2	2	2	12	Failed	Consolidated under energy consumption indicator
Gas consumption	1	1	1	1	1	1	6	Failed	Energy sub-component; not independently assessed in classrooms
Energy required for ventilation systems and strategies	0	1	0	0	1	1	3	Failed	Highly technical metric requiring simulation rather than field measurement
Perceived environmental factors affecting attention	1	1	1	1	1	1	6	Failed	Subjective perception indicator lacking standardized scale
Biological pollutants (e.g., mold, bacteria)	1	1	1	1	1	1	6	Failed	Subsumed under moisture and mold classification
Energy consumption	2	2	2	2	2	2	12	Passed	Quantifiable operational sustainability indicator
Overall cleaning and maintenance	1	1	1	1	1	1	6	Failed	Overlapping descriptor incorporated under cleanliness
Access to electric outlets	2	2	2	2	2	2	12	Passed	Functional environmental adequacy indicator affecting usability
Energy efficiency	2	2	2	2	2	2	12	Passed	Core sustainability indicator reflecting building performance

Note:

M – Measurability; R – Relevance; Rel – Reliability; DA – Data Accessibility; U – Understandability; LTA – Long-term Applicability; Total – Total Score.

Scores were assigned using a 0–2 ordinal scale (0 = not satisfied, 1 = partially satisfied, 2 = fully satisfied), with a maximum total score of 12.

Classification is based on total score: Passed (10–12), Borderline (7–9), and Failed (0–6).

Table 6. Screening Results of Spatial Quality Indicators With Pass–Fail Classification and Justification

Spatial Quality Indicator	M	R	Rel	DA	U	LTA	Total	Screening Result	Justification
Building condition	2	2	2	2	2	2	12	Passed	Fundamental spatial adequacy indicator reflecting structural and functional integrity
Furnishings	1	1	1	1	1	1	6	Failed	Consolidated under furniture and furnishings indicator
Aesthetics	0	1	0	1	1	1	4	Failed	Subjective visual perception lacking standardized assessment scale
Visual inspection	0	1	0	1	1	1	4	Failed	Assessment method rather than an indicator
Technology	2	2	2	2	2	2	12	Passed	Represents availability of instructional and spatial-support technologies
Building characteristics	2	2	2	2	2	2	12	Passed	Core spatial descriptor including layout, size, and spatial configuration
Building system	2	2	2	2	2	2	12	Passed	Reflects functionality of integrated building services supporting space use
Furniture	1	1	1	1	1	1	6	Failed	Consolidated under furniture and furnishings
Distance to window	2	2	2	2	2	2	12	Passed	Spatial daylight access indicator influencing comfort and usability
Controlling windows, lighting, and shading	2	2	2	2	2	2	12	Passed	Indicator of occupant environmental control within space
Architectural quality	0	1	0	1	1	1	4	Failed	Broad qualitative construct without operational measurement definition
Ergonomics	2	2	2	2	2	2	12	Passed	Measurable human–space interaction indicator affecting posture and comfort

Note:
M – Measurability; R – Relevance; Rel – Reliability; DA – Data Accessibility; U – Understandability; LTA – Long-term Applicability; Total – Total Score.
Scores were assigned using a 0–2 ordinal scale (0 = not satisfied, 1 = partially satisfied, 2 = fully satisfied), with a maximum total score of 12.
Classification is based on total score: Passed (10–12), Borderline (7–9), and Failed (0–6).

Table 7. Screening Results of Other Indicators Identified With Pass–Fail Classification and Justification

Other Indicator	M	R	Rel	DA	U	LTA	Total	Screening Result	Justification
Perception	0	1	0	1	1	1	4	Failed	Broad subjective construct overlapping multiple IEQ outcome variables without standardized measurement scale
Student performance	0	0	0	1	1	1	3	Failed	Educational outcome variable rather than an environmental exposure indicator
Learning outcomes	0	0	0	1	1	1	3	Failed	Long-term academic result influenced by multiple non-environmental confounders
Teacher actions	0	0	0	1	1	1	3	Failed	Behavioral and pedagogical factor unrelated to physical indoor environmental conditions
Occupancy level	1	1	1	1	1	1	6	Failed	Contextual modifier rather than a comfort or quality indicator; treated as control variable
Construction practices	0	0	0	1	1	1	3	Failed	Process-oriented variable applicable to project delivery, not post-occupancy IEQ assessment
Adaptive opportunities	1	1	1	1	1	1	6	Failed	Behavioral adaptation concept incorporated indirectly within thermal comfort models
Psychosocial factors	0	1	0	1	1	1	4	Failed	Non-physical environmental determinants lacking standardized IEQ measurement protocols
Individual and allergic characteristics	0	0	0	1	1	1	3	Failed	Highly person-specific health attributes unsuitable for building-level assessment
Allergies and asthma prevalence	0	0	0	1	1	1	3	Failed	Population health outcome rather than environmental exposure indicator
Sustainability (general)	0	1	0	1	1	1	4	Failed	Macro-level concept operationalized through specific indicators rather than as a standalone variable
Heart rate	1	0	1	0	1	1	4	Failed	Physiological biomarker requiring wearable sensors and ethical clearance; impractical for field deployment
Skin temperature	1	0	1	0	1	1	4	Failed	Invasive physiological measurement not feasible for large-scale longitudinal studies
Health impact	0	0	0	1	1	1	3	Failed	Aggregated outcome variable influenced by multiple environmental and non-environmental determinants

Note:
M – Measurability; R – Relevance; Rel – Reliability; DA – Data Accessibility; U – Understandability; LTA – Long-term Applicability; Total – Total Score.
Scores were assigned using a 0–2 ordinal scale (0 = not satisfied, 1 = partially satisfied, 2 = fully satisfied), with a maximum total score of 12.
Classification is based on total score: Passed (10–12), Borderline (7–9), and Failed (0–6).
Passed * - Passed indicates indicators that satisfied the screening criteria but were excluded from the final indicator set due to redundancy, conceptual overlap, or consolidation under standardized terminology. Justifications for exclusion are provided in the table.