



Department
for Education

School Output Specification

**Technical Annex 2K: Building
Performance Evaluation Methodology**

November 2021

Document Control

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P01	S2	2021-04-19	AWI	General technical review and update, introduction of Uniclass coding, and improved performance in use standards
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Summary

Technical Annex 2K provides the minimum requirements for the evaluation of buildings. It defines the methodology to be used. It is to be read in conjunction with the Generic Design Brief (GDB) the School Specific Brief (SSB).

Review Date

Review dates for this document shall be at 6-month intervals.

Who is this publication for?

This document is for technical professionals involved in the design and construction of school premises, to use as part of the Employer's Requirements of the DfE Construction Frameworks (the DfE Construction Framework 2021 and the Offsite Schools Framework (incorporating Modular and MMC delivery) (MMC)). It may also be used as the basis of similar documentation for other procurement routes using the Output Specification.

Uniclass Codes

This document captures Uniclass codes for the management of exchange of information. To access all codes and associated titles reference should be made to [Uniclass 2015 | NBS \(thenbs.com\)](https://thenbs.com)

1. Introduction

1.1. Overview

1.1.1. This document is one of the Technical Annexes that forms part of the Generic Design Brief (GDB). [PM_10_20]

1.1.2. The definitions listed in GDB shall apply to this Technical Annex and all other parts of the Output Specification. [PM_10_20]

1.1.3. This document shall be read in conjunction with the GDB and all other Technical Annexes as well as the School-specific Brief (SSB), including the School-specific Annexes. [PM_10_20]

1.1.4. This document sets out the required technical standards and performance criteria for Building Performance Evaluation Methodology. [PM_10_20]

1.1.5. The information exchange required at each stage of the design, build and completion process is detailed in the DfE's Exchange Information Requirements (EIR). [PM_10_20_28]

1.1.6. The requirements in this Technical Annex shall apply to all parts of the works; New or Refurbished. [PM_10_20]

2. Building Performance Evaluation Methodology

2.1. Overview

2.1.1. Research carried out by the Department for Education (DfE) into newly completed and occupied school buildings has identified there is often a performance gap between the Contractor's design intent and the in-use performance of the Building. [PM_70_95_64]

2.1.2. As a result, the DfE has developed a strategy to carry out a Building Performance Evaluation (BPE) of all new school buildings. [PM_80_10_65]

2.1.3. The aim for the evaluations, as part of the normal procurement process, is to:

- a) Indicate the factors impacting on the operational performance of the Building in use. [PM_80_10_65]
- b) Identify the root cause of performance issues. [PM_80_10_65]
- c) Inform action to improve performance. [PM_80_10_65]

2.1.4. Many factors impact the performance of school buildings including:

- a) Design strategies and complexity of systems. [PM_10]
- b) Cost cutting during the design development and construction phases. [PM_10]
- c) Configuration of controls. [PM_10]
- d) Commissioning of systems, handover and aftercare service. [PM_10]
- e) User understanding of systems and training in their use. [PM_10]
- f) Operational management of the School. [PM_10]

2.1.5. Poor performance increases running costs and can have a detrimental impact on educational attainment. For example, poor ventilation can affect concentration levels as teaching spaces become increasingly stuffy through the day. [PM_10]

2.1.6. The focus of this methodology is on providing a structured and auditable procedure for uncovering poor performance issues. In conjunction with the Employer and end users, the Contractor shall decide upon the most appropriate course of action to remedy the problems. [PM_80_10_65]

2.1.7. Contractors and their designers are key players in unlocking good building performance. Therefore, the BPE methodology has been specifically designed to be used

within the first year of operation of the school Building whilst there is still a Contractor responsibility with the School through the defects liability period. [PM_80_10_65]

2.1.8. The DfE's Output Specification contains a requirement for the Contractor to ensure that BPE's are provided and is a specific contract deliverable. [PM_80_10_65]

2.1.9. Whilst there are various approaches that can be taken to achieve a successful BPE, the methodology described in this document provides a robust set of instructions for meeting the requirements. [PM_10]

2.1.10. The process is designed to be led by Contractors who have a good understanding of the Building and its systems. [PM_80_10_65]

2.1.11. Some of the issues highlighted through the BPE process are addressable through the normal snagging/defects resolution activities carried out by Contractors. However, it is fully expected that some of the issues go beyond the Contractor's original responsibilities and therefore shall be considered on a case-by-case basis. [PM_80_10_65]

2.1.12. The BPE methodology is intended to be used on new and Refurbished Buildings. [PM_80_10_65]

2.1.13. The installed Building's metering systems shall allow data to be logged for the electricity, gas and water consumption. For more information on these requirements see Technical Annexes 2H and 2I. [FI_30]

2.2. Methodology

2.2.1. Scope of the Building Performance Evaluation (BPE) Process

2.2.1.1. The scope of the BPE process is:

- a) To provide an objective understanding of what is successful and what are areas for improvement. [PM_80_10_65]
- b) To monitor the result of fine tuning the building performance through seasonal adjustments to the building controls. [PM_80_10_65]
- c) To establish across the range of schools where there are common issues in order to learn lessons for future school building projects. [PM_80_10_65]

2.2.1.2. Two BPE reviews shall be carried out. An initial Review at 3-6 months and a Final Review at 9-12 months after handover in accordance with the DfE's EIR. [PM_10_20_28]

2.2.1.3. This is a process that looks at various interrelated aspects of school buildings. The assessment looks for areas that can be improved and then suggests actions. It comprises:

- a) A desktop analysis of specific design and construction information on the School before the school visit, with option for BPE client team to attend. [PM_80_10_65]
- b) A two-part school visit with a walk around the School – generally with the Headteacher or Bursar (responsible budget holder), school site supervisor (Caretaker/Premises Manager), the Contractor (including M&E and controls specialists), with option for BPE client team, to attend, including the completion of questionnaires. [PM_80_10_65]
- c) Records made through photos, notes, observations and conversations on walk around. [PM_80_10_65]
- d) A review of the Building Management System (BMS) demonstrated by site staff. This provides an easy indication of the level of training provided by the Contractor to the School technical staff and the level of commissioning of the systems. [PM_80_10_65]
- e) Post school visit: A desktop analysis of the energy data and questionnaire responses with a write up of the findings using evidence of data; action plan for the different parties, i.e., Contractor, School and DfE. This is supported by analysis of any further energy, temperature or CO₂ data that can be obtained. [PM_80_10_65]
- f) A report on all the findings, energy trends and observations from each school – issued to DfE using DfE templates for the Initial and Final BPE reports. [PM_80_10_65]
- g) An action plan prioritised according to the most significant risks as agreed between all parties. [PM_80_10_65]
- h) A short summary report for the School. [PM_80_10_65]
- i) An overall report on the batch of schools for DfE if part of a batch. [PM_80_10_65]

2.2.1.4. The BPE process is primarily concerned with evaluating the performance of buildings in use, however in order to get meaningful outputs it is necessary that preparations for the main BPE activities are made at the design and construction stages. [PM_80_10_65]

2.2.1.5. These preparations revolve around the provision of suitable data monitoring and collection systems for the electricity, gas and water consumption in the Building and training that forms part of the building handover. [PM_10_20_82]

2.2.1.6. Once the Building is in-use these monitoring systems shall be vital in providing the hard technical data used in the assessment of the building's performance. [PM_10]

2.2.1.7. The activities carried out in the first year of operation are split over two distinct stages, post-handover.

- a) The first stage shall be performed within the first 6 months after handover and is focused on ensuring the Building is set up correctly for the purpose of accurately reporting its ongoing performance. [PM_80_10_65]
- b) The second stage is a more detailed assessment of the overall building performance and allows annual energy/water consumption to be recorded based on actual figures. [PM_80_10_65]

2.2.1.8. The stages and activities used in the methodology are shown in the following table. [PM_80_10_65]

Stage	When Undertaken	Activities	Information to be provided / Employers Requirements Deliverables
Stage 1 - Data collection setup	Commissioning	Ensure data monitoring and sub-metering systems are correctly collecting data and automatically reporting.	Results of 7 day monitoring during soak test (forms part of H&S file).
Stage 2 - Initial performance review	3-6 months post occupancy	Site visit and walk around with School management team and Contractors. Collect and review initial building performance iSERV data and BMS energy consumption data (electricity, gas, water, temperature, CO ₂ in classrooms) and compare against design predictions. Conduct structured interview of facilities staff/ questionnaire. Complete teaching staff questionnaires.	Initial BPE performance report showing top 5 issues and initial energy and water consumption/ performance. Action plan to resolve issues before the end of the defect liability period and final BPE review.

		<p>Collate all information into the initial report template and provide commentary on the findings.</p> <p>Develop action plan to address any issues identified, e.g., further training, seasonal adjustments and fine tuning.</p> <p>Report findings back to the School.</p>	
<p>Stage 3 - Final performance review</p>	<p>9-12 months post occupancy</p>	<p>Collect and review longer term building performance iSERV data and BMS energy consumption data (electricity, gas, water, temperature, CO₂ in classrooms).</p> <p>Conduct structured analysis of data collected accounting for any unexpected results.</p> <p>Collate all information into the final report template and provide commentary on the findings.</p> <p>Develop any further action plan.</p> <p>Report findings back to the School and DfE.</p>	<p>Final BPE report showing confirmed performance and actual annual energy and water consumption figures achieved with a comparison against the design predictions and DfE benchmarks.</p> <p>Any further actions to improve performance?</p>

Table 1 – BPE stages and requirements

2.2.2. Stage 1 - Data Collection Setup (Handover Period - Pre-Occupancy)

2.2.2.1. The setup of the data collection systems is an important step to achieve building performance in use. [PM_10]

2.2.2.2. In line with the DfE requirements, the School shall be provided with main metering for all the incoming utilities and sub-meters. As a minimum these shall be supplied on each of the following:

- a) gas to boilers [Ss_75_70_54_30]
- b) gas to kitchen [Ss_75_70_54_30]
- c) water supply [Ss_75_70_54_95]
- d) main electrical intake [Ss_75_70_54_25]
- e) kitchen general power [Ss_75_70_54_25]
- f) external lighting and power [Ss_75_70_54_25]
- g) HVAC control panel for centralised mechanical ventilation systems [Ss_75_70_52_94]
- h) server room general power [Ss_75_70_54_25]
- i) plant room general power [Ss_75_70_54_25]
- j) each floor general power [Ss_75_70_54_25]
- k) each floor lighting [Ss_75_70_54_25]
- l) any low or zero carbon energy sources except biomass [Ss_75_70_54]
- m) trend comparison between each day or week for all meters [Ss_75_70_54]
- n) local display on the sub-meters with centralised recording, monitoring and trend logging, with sampling at a minimum of every 15 minutes [Ss_75_70_54]
- o) automatic monthly data upload from all sub meters to iSERV. [Ac_05_50_54]

2.2.2.3. These meters, along with any additional and specialist meters, are required to be logged at 15-minute intervals via an Automatic Meter Reading (AMR) system. [Ac_05_50_54]

2.2.2.4. During the commissioning stage the Contractor shall be responsible for ensuring all the sub-metered data is both collected by the AMR system and accurately represents the actual performance of the systems being monitored. [FI_30]

2.2.2.5. The BPE shall utilise the data collected from these metered systems and so it is important that they are correctly commissioned. [FI_30]

2.2.2.6. The data collected from the meters is not the only source of technical data on the performance of a school building, data collected by the BMS can also provide useful feedback. [FI_30]

2.2.2.7. Where room temperature and CO₂ data is being sent to the BMS then this too shall be logged and is to be drawn on during the BPE data analysis phase. [FI_30]

2.2.2.8. Upon completion of the setting to work and commissioning of the building services, a “soak test” shall be performed of the systems installed by running the systems continuously for a 7 day period as follows:

- a) Continue plant operation until 7 continuous days have occurred without fault or failure of any component or function. [PM_70_15_82]
- b) Monitor all functions (pressures/temperatures/starts per hour, sub metering etc.) which shall be trend logged using the microprocessor controls equipment where installed. [PM_70_15_82]
- c) Monitor each type of space served by the plant and equipment using temperature data loggers (supplied by the Mechanical or Electrical Contractor) or the BMS system to verify performance. [PM_70_15_82]
- d) Any specified noise performance surveys shall also be carried out during this period. [PM_70_15_82]
- e) All data shall be downloaded in Excel spreadsheet format (electronic and hard copy) and should be available during the BPE reviews. [PM_70_15_82]
- f) All data and monitoring results shall be reported to the Employer and included in the H&S file alongside the other commissioning and test certificates. [PM_70_15_82]

2.2.3. Stage 2 - Initial Performance Review (3 - 6 Months Post Occupancy)

2.2.3.1. General

2.2.3.1.1. An initial BPE shall be carried out between 3 - 6 months after handover. This shall comprise:

- a) analysis of information relating to the project before the visit such as Contractors’ Proposals design information, as installed (record) information, controls philosophy, M&E schematics, sub-metering schematic, Building User Guide [PM_10_20_82]
- b) a site visit and walk around/meeting with the School – generally the Headteacher, school Bursar, school site supervisor (Caretaker/Premises Manager), the Contractor (including contract manager, M&E and controls specialist) [PM_10_20_82]
- c) photos of the School and elements reviewed [PM_10_20_82]
- d) a completed FM questionnaire [PM_10_20_82]
- e) completed Teaching Staff questionnaires [PM_10_20_82]
- f) review of the BMS system and energy data, and comparison against design predictions and DfE benchmarks. [PM_10_20_82]

2.2.3.1.2. Follow up actions after the initial meeting shall comprise:

- a) analysis of the data collected for each school [PM_10_20_82]
- b) compilation of a report on all findings, energy trends and observations from each school issued to DfE with clear actions by the Contractor [PM_10_20_82]
- c) compilation of a short summary report for the School [PM_10_20_82]
- d) overall report on the batch of schools for DfE, if part of a batch project [PM_10_20_82]
- e) all reports to follow the standard DfE format for BPE reviews. [PM_10_20_82]

2.2.3.1.3. Seasonal commissioning adjustments shall be conducted throughout the first year of the Building's performance following handover by the Contractor. [PM_10_20_82]

2.2.3.1.4. The primary purpose of the initial BPE is to identify any obvious gaps in the handover process and ensure that the school's data collection systems are providing useful information. It is a sense check that the Building is performing within the expected range and to put in place any necessary corrective actions. [PM_10]

2.2.3.2. Desktop analysis

2.2.3.2.1. The desktop analysis identifies the areas of focus for the visit by BPE team, with knowledge on what to expect on the systems and components known to impact on the building performance. It involves a review of the design information available against what was finally constructed. [PM_80_10_60]

2.2.3.3. Site walk around

2.2.3.3.1. This is an invaluable exercise providing a quick and effective visit as:

- a) the School gets an early indication they are going to benefit from this process, which builds trust and engages the School to talk about how they use the Building, which impacts on building performance. [PM_10]
- b) it provides buy-in by the School to complete the supporting questionnaires. The one for technical staff is completed there and then, whilst teaching staff are left copies to complete in a staff meeting (10 minutes long). Secondary Schools shall find it easier to coordinate responses through Heads of Departments. [PM_10]
- c) it quickly gives a feel for the School's attention to managing behaviour which impacts on building performance [PM_10]
- d) the Contractor sees the ability of the School to use, operate and manage components they have designed and built where the focus for effective training needs to be e.g., school Caretaker confident in heating, electrical controls, seasonal maintenance, however not confident in BMS operation. [PM_10]

2.2.3.4. Facilities staff questionnaires/interview

2.2.3.4.1. An interview shall be conducted with one or more members of the facilities staff. These interviews are based around a set of multiple-choice questions, See Appendix A. There is an opportunity for the interviewee to provide additional information to support their answers. [PM_10_20]

2.2.3.4.2. It is intended that the interviewer asks all the questions provided, but it is acknowledged that it might be necessary to ask further site-specific questions to get to the root cause of certain issues. Where this occurs the additional questions and answers shall be recorded at the end of the standard questions. [PM_10_20]

2.2.3.5. Teaching staff questionnaires

2.2.3.5.1. This stage seeks feedback from building users on their experiences of working in the Building. [PM_40_60_62]

2.2.3.5.2. This is done via a questionnaire, which is primarily aimed at the teaching staff, but other staff can also be included. [PM_40_60_62]

2.2.3.5.3. Students shall not be directly asked about their experience of the Building. Instead, it is anticipated that teaching staff shall reflect the experience of the students in their answers. [PM_40_60_62]

2.2.3.5.4. The aim should be to gather as many survey responses as possible, to maximise the understanding of the Building's operation. [PM_40_60_62]

2.2.3.5.5. The survey questions are focused on the following building conditions:

- a) Winter temperature. [PM_10_20]
- b) Summer temperature. [PM_10_20]
- c) Ventilation and general air quality. [PM_10_20]
- d) Lighting, both from daylight and electric lights. Glare from the lights shall also be considered. [PM_10_20]
- e) Noise levels. [PM_10_20]

2.2.3.5.6. A copy of the questionnaire is included at Appendix B. [PM_40_60_62]

2.2.3.6. Energy data collection and review

2.2.3.6.1. As the Building has been operational for a relatively short period of time care shall be taken when attempting to interpret the metered data as it may not be providing an accurate picture of the energy consumption patterns. [PM_70_95_64]

2.2.3.6.2. This is because there may not have been enough time for all the systems to run-in to their full operating state and the impact of any seasonal variations have not been experienced. In addition to this there may still be a Contractor presence on site which could contribute to the energy consumption seen. Despite this, collecting and reporting this data is still a worthwhile exercise as problems with systems can be identified if utilities are being used out of hours unnecessarily. [PM_70_95_64]

2.2.3.6.3. The data shall be presented in a table showing at least the following information for each meter and sub-meter:

- a) Utility being monitored (e.g., gas, electricity etc). [PM_10_20]
- b) Meter ID. [PM_10_20]
- c) Consumption since start of building occupation. [PM_10_20]
- d) Average consumption per day. [PM_10_20]
- e) Average out of hours consumption per day. [PM_10_20]

2.2.3.6.4. Reports on daily peak demands shall be included to allow any anomalies to be identified as well as confirming the correct operation of the controls. [PM_10_20]

2.2.3.6.5. The use of iSERV to continually monitor energy consumption is the required system for reporting the data. The web-based iSERV database shall be reviewed to ensure the data is being reported correctly. The data reporting takes the form of an automated email sent to iSERV that contains the monitored energy consumption data in a CSV format. The database has been designed to aid in providing operational feedback of buildings, and to make energy analysis simple, unambiguous and robust. The reports produced by the iSERV system are to be used directly in the summary BPE reports. Further details of in use energy monitoring are given in Appendix E. [Ac_05_50_54]

2.2.3.7. Analysis of the performance data and user feedback

2.2.3.7.1. It is important to consider the relationship between the findings of the survey questions, the interviews, and the performance data. For example, a general response from building users of low internal temperatures may correspond with a low gas consumption

compared to benchmarks and increasing the temperature may take the gas consumption well above the benchmark. This would indicate that there is a technical issue with the Building's heating that needs to be investigated fully in order to increase winter temperatures, without significantly increasing fuel consumption. [PM_10_20]

2.2.3.8. Reporting format for initial BPE review

2.2.3.8.1. The Initial Performance Review Report template is provided in Appendix C. [PM_10]

2.2.3.9. Action plan for resolving issues identified

2.2.3.9.1. Investigating the issues highlighted by the analysis in the previous step shall result in a list of actions for the Contractor to take forward or potentially raise as an action in conjunction with the School. Any action that is required to bring the Building in line with the Contractor's original scope shall be implemented as soon as possible with the provision of additional training or recalibration of controls and metering. [PM_60_30_05]

2.2.3.9.2. All actions identified shall be presented as a plan that shall allow further success to be achieved by the final BPE review date after 12 months of building occupation. [PM_60_30_05]

2.2.3.9.3. Once the action plan has been prioritised it shall be presented to the School along with the rest of the findings of the BPE. [PM_60_30_05]

2.2.4. Stage 3 - Final Performance Review (9 - 12 Months Post Occupancy)

2.2.4.1. General

2.2.4.1.1. The Final Performance Review builds on the work undertaken in the Initial Performance Review by reviewing additional energy data following up on the initial BPE review outcomes and the results of the Contractors' action plan. All conclusions are then presented in a final BPE report using the template provided in Appendix D. [PM_10_20]

2.2.4.1.2. The initial BPE review conducted after the School has been in use for 3-6 months gives schools a chance to settle into their new building and allow them an understanding of its day-to-day operation. [PM_10]

2.2.4.1.3. It also allows a more measured approach to be taken to calibration and reporting from the sub-metering and identifies any additional training requirements. [PM_10]

2.2.4.1.4. Allowing these issues to be addressed early provides an opportunity to collect more relevant data about the building operation and success of the second BPE review held towards the end of the Defects Liability Period (DLP). [PM_10]

2.2.4.1.5. The extent of this final BPE review shall vary depending on the School – at best it provides data collection around the energy performance of the Building giving a full year of results and showing any results of seasonal adjustments; at worst it may involve a further site visit and analysis of data if this was unsuccessful following the first site visit. [PM_10]

2.2.4.2. Energy data collection and review

2.2.4.2.1. The readings from the main meters and sub-meters shall be collected for the entire period since the building was occupied. [PM_10_20_82]

2.2.4.2.2. The trends shall be shown as monthly summaries to allow seasonal variations to be easily seen. [PM_10_20_82]

2.2.4.2.3. In addition to this the consumption for at least two different days shall be shown graphically (as per the example in Figure 1). The days chosen shall be full school days, and ideally be from the winter and the summer to allow the full variation in consumption to be seen. [PM_10_20_82]

2.2.4.2.4. These daily profiles shall provide clear visibility on how the Building is performing on a more detailed level than is possible from simple daily meter readings. [PM_80_10_60]

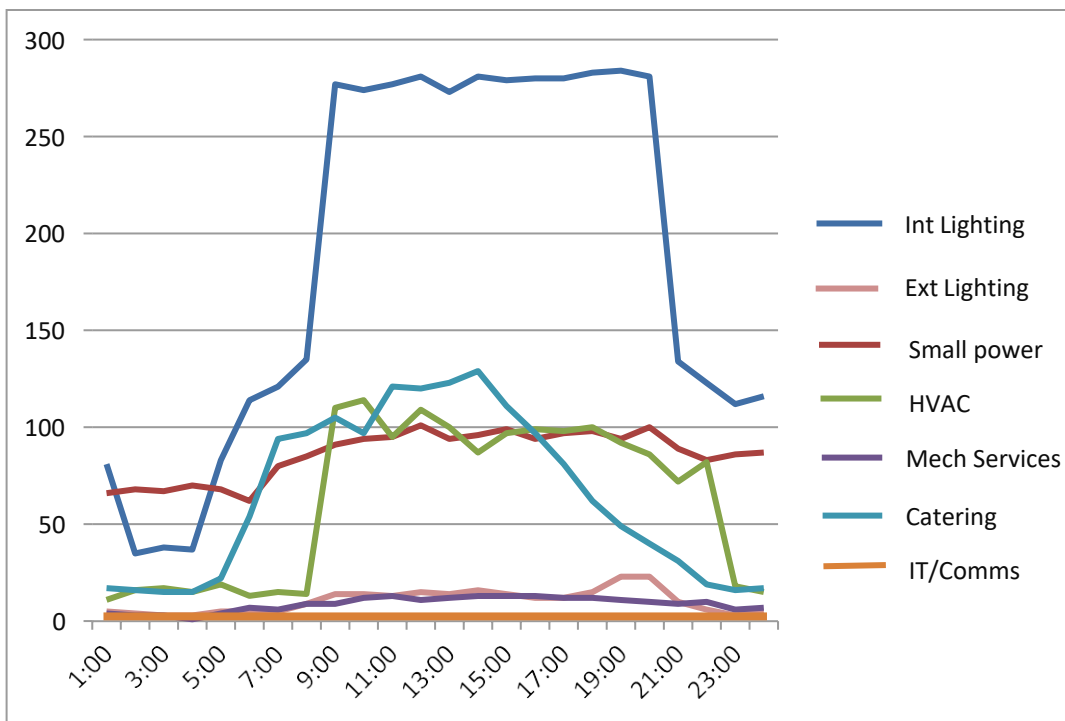


Figure 1 – Example of a daily energy profile for a single day in a school

2.2.4.2.5. By examining the daily consumption profile in detail, it shall be possible to see when the main systems such as the heating, lighting and ventilation are switched on and off. [PM_10]

2.2.4.2.6. Any systems that are operating out of hours unnecessarily can be clearly identified and rectified. [PM_10]

2.2.4.2.7. An attempt shall be made to reconcile the energy use pattern with the known activities taking place at the School. [PM_10_20_82]

2.2.4.2.8. Any inconsistencies noted between energy use and the activities that drive it shall be investigated further. [PM_10_20_82]

2.2.4.3. Energy data comparison against energy targets

2.2.4.3.1. Energy data comparison against energy targets shall be made as follows:

- a) For all New Buildings, whether a Partial or Whole School Project, an energy review shall be undertaken against the energy targets as described in the Technical Annex 2H, and also against the Contractors' design predictions. [PM_70_95_20]

- b) Energy targets are expressed as electricity equivalent kWhe. [PM_10_20_82]
- c) kWhe is calculated by multiplying the different fuel kWh consumptions by the relevant energy weighting factor. [PM_10]

Category	Description	Energy Weighting Factor*
Electricity	includes mains electricity, electricity from combined heat and power and renewable energy	1
All fuels	includes gas, oil, and biofuels	0.4
All thermal energy	includes geothermal, district heat and heat from combined heat and power and solar thermal	0.5

Table 2 – Energy Weighting Factors

* The energy targets are quoted based on the Operational Hours detailed in Section 4 of GDB Technical Annex 2H.

2.2.4.3.2. In addition to the metered data collected by the AMR, the additional data on temperature and CO₂ levels within classrooms available on the BMS shall be reported. It provides confirmation of correct operation of controls and allows fine tuning and seasonal adjustments to be made to minimise energy consumption. [FI_30]

Type	Heating	Hot Water	Small Power	Internal Lighting	External lighting	Fans & Pumps	Server Room	Catering	Cooling	Lifts	Total
Electrical equivalent (kWh/m ²)	8	5	10	8	6	5	0	7	0	1	52*

Table 3 – Annual Design Energy Targets - Primary

Note: Allow 2 kWh/m² for building related services

Type	Heating	Hot Water	Small Power	Internal Lighting	External Lighting	Fans & Pumps	Server Room	Catering	Cooling	Lifts	Total
Electrical equivalent (kWh/m ²)	8	5	25	8	6	5	0	7	0	1	67*

Table 4 – Annual Design Energy Targets - Secondary

Note: Allow 2 kWh/m² for building related services

2.2.4.4. Facility staff

2.2.4.4.1. The structured interviews with the facilities staff shall ask the same questions that were asked during the Initial Performance Review and progress on the issues previously identified is to be fully tracked. [PM_70_85_25]

2.2.4.4.2. It is also possible that new issues may have come to light in the intervening time with regards to systems which are only required at certain times of the year such as heating or cooling. [PM_70_85_25]

2.2.4.4.3. The issues raised by teaching staff in their responses to the questionnaires shall be confirmed through the facilities team as having been suitably actioned since the initial BPE visit. [PM_70_85_25]

2.2.4.5. Teaching staff

2.2.4.5.1. Further teaching staff questionnaires are not required to be completed as resulting actions from the initial BPE review shall have been completed through the initial review action plan. [PM_10_20_82]

2.2.4.5.2. In the event of significant issues being identified at the initial BPE review in some circumstances it may be appropriate to re-survey the teaching staff so that these updated results can be included in the final BPE report. [PM_70_85_25]

2.2.4.6. Analysis of the performance data and user feedback

2.2.4.6.1. Overall analysis of the building performance, supported by actual annual energy consumption data and seasonal performance of the Building shall now be provided. A commentary against benchmarks and the design prediction can be made. [PM_80_10_60]

2.2.4.6.2. The results of the action plan undertaken as result of the initial BPE review shall record any seasonal commissioning adjustments that resulted in improved building performance. [PM_80_10_60]

2.2.4.7. Reporting format for final BPE report

2.2.4.7.1. The Final Performance Review Report template is provided in Appendix D. [PM_10]

2.2.4.8. Action plan for any outstanding items

2.2.4.8.1. Include details of any proposed further action that is required. [PM_10_20_82]

Appendix A

Building Performance Evaluation - Facilities staff questionnaire

1. Overview

1.1. The Facilities Staff Interview is a vital part in achieving better performing school buildings. [PM_10]

1.2. It forms part of the Building Performance Evaluation and provides the insight into the criteria which effect educational and operational performance. [PM_10]

1.3. It will help the school users (staff and students) and the school's technical and operational team to get a clear understanding of how the Building is performing in use in order to inform necessary action. [PM_10]

1.4. It shall also inform the design and operation of future educational buildings. [PM_10]

2. Completing the interview

2.1. If any question has a qualifying remark, note this is under the question. [PM_10_20]

2.2. Try to summarise any long answers into the key points(s) relating to the question. [PM_10_20]

2.3. If the interviewee does not have the experience with the system in question, skip all the questions on that system. [PM_10_20]

- 1) Do you have any responsibility for the operation and/or maintenance of the Building's heating systems?

Yes / No

Additional Comments

- 2) The training provided on the operation and maintenance of the heating system was:

Good / Inadequate / Too complex

Additional Comments

3) The heating controls are:

Simple to use / Moderately simple to use / Complex to use

Additional Comments

4) The level of feedback on the heating system provided by the control system is:

Good / Inadequate / Too detailed

Additional Comments

5) Issues with the heating systems are:

Easy to identify / Slightly difficult to identify / Difficult to identify

Additional Comments

6) Maintenance of the heating system is:

Easy / Moderately Difficult / Difficult

Additional Comments

7) Do you have responsibility for the operation and/or maintenance of the Building's cooling and ventilation systems?

Yes / No

Additional Comments

8) The training provided on the operation and maintenance of the cooling and ventilation systems was:

Good / Inadequate / Too complex

Additional Comments

9) The cooling and ventilation controls are:

Simple to use / Moderately simple to use / Complex to use

Additional Comments

10) The level of feedback on the cooling and ventilation systems is:

Good / Inadequate / Too detailed

Additional Comments

11) Issues with the cooling and ventilation systems are:

Easy to identify / Slightly difficult to identify / Difficult to identify

Additional Comments

12) Maintenance of the cooling and ventilation systems is:

Easy / Moderately difficult / Difficult

Additional Comments

13) Do you have any responsibility for the operation and/or maintenance of the Building's lighting?

Yes / No

Additional Comments

14) The training provided on the operation and/or maintenance of the lighting systems was:

Good / Inadequate / Too complex

Additional Comments

15) The lighting controls are:

Simple to use / Moderately simple to use / Complex to use

Additional Comments

16) Access to the light fittings for cleaning, replacement and maintenance is:

Easy / Moderately difficult / Difficult

Additional Comments

17) Using the metering system to compare energy consumption over the weekend with the weekday consumptions is:

Easy / Difficult / Not possible

Additional Comments

18) Comparing the energy consumption of this week with last week with the metering system is:

Easy / Difficult / Not possible

Additional Comments

19) The training provided for monitoring and reporting the school's water and energy use was:

Good / Inadequate / Too complex

Additional Comments

20) In terms of helping to understand, operate and manage the school, the contractor's Aftercare Service was:

Full and Complete / Partly Complete / Inadequate

Additional Comments

21) Cleaning the school building is:

Completely straight forward / Partly straightforward / Difficult

Additional Comments

Please add any further comments and expand on any answers where improvement measures are required.

Comments

Appendix B Building Performance Evaluation - Teaching staff interview questionnaire

1. Overview

1.1. The Teaching Staff Survey is a vital part in achieving better performing school buildings. [PM_10]

1.2. It forms part of the Building Performance Evaluation and provides insight into the criteria which effects educational and operational performance. [PM_10]

1.3. It shall help the staff and students, and the School's technical and operational team to get a clear understanding of how the Building is performing in order to inform necessary action. [PM_10]

1.4. It shall also inform the design and operation of future educational buildings. [PM_10]

2. Completing the survey

About you: Female / Male

Classroom name / number

Your answers should refer to the room you spend the most amount of time in. Place a tick or cross to identify which is the most relevant answer to you.

1) In winter, the temperature in my classroom in the morning is:

Too hot / Too cold

2) In winter, the temperature in my classroom at the end of the day is:

Too hot / Too cold

- 3) In winter, my classroom's temperature is suitable for different teaching scenarios (e.g., lecturing, group work, practical work etc.):

For all scenarios / For some scenarios / For no scenarios

Provide further details if heating is not suitable for some or all teaching scenarios.

- 4) The winter air quality in the classroom is best described as:

Stuffy / Dry / Good / Draughty / Humid

- 5) The heating controls for the classroom provide:

Poor temperature control / Good temperature control / N/A (i.e., no controls)

Provide further details if the temperature control is poor.

- 6) The heating controls (thermostats, radiators etc.) in the classroom are:

Difficult to use / Easy to use / N/A (i.e., no controls)

Provide further details if controls are difficult to use.

- 7) The level of training given on how to regulate the winter temperature in my classroom was:

Missing / Inadequate / Good

8) In winter, the temperature in the corridors is:

Too hot / Too cold / Comfortable

9) In winter, the temperature in the gym/assembly hall/cafeteria/toilets is:

Too hot / Too cold / Comfortable

Provide further details if too hot or cold in some or all these spaces.

10) In summer, the temperature in my classroom in the morning is:

Too hot / Too cold / Comfortable

11) In summer, the temperature in my classroom at the end of the day is:

Too hot / Too cold / Comfortable

12) In summer, my classroom's temperature is suitable for different teaching scenarios (e.g., lecturing, group work, practical work etc.):

For all scenarios / For some scenarios / For no scenarios

Provide further details if the summer temperature is not suitable for some or all teaching scenarios.

13) The summer air quality in the classroom is best described as:

Stuffy / Dry / Good / Draughty / Humid

14)The summer ventilation controls for classroom provide:

Poor temperature control / Good temperature control / N/A (i.e. no controls)

Provide further details if ventilation control is poor.

15)The summer ventilation controls in the classroom are (give details in the comments section below):

Difficult to use / Easy to use / N/A (i.e., no controls)

Provide further details if ventilation controls difficult to use.

16)The level of training given on how to regulate the summer temperature in my classroom was:

Missing / Inadequate / Good

17) In summer, the temperature in the corridors is:

Too hot / Too cold / Comfortable

18) In summer, the temperature in the gym /assembly hall/cafeteria/toilet is:

Too hot / Too cold / Comfortable

Provide further details if too hot or cold in some or all these spaces.

19) Do you always turn the lights on when you enter the classroom?

No / Yes / Automatic lights

20) During the day can you teach successfully under solely daylight conditions?

No / Yes

21) The lighting in the classroom is:

Too bright / Too dim / Appropriate

22) Are there any issues with light quality?

Light colour issues / Light flicker issues / None

23) Are there any issues with glare from sunlight in the classroom?

No / Yes

24) It is difficult to read from display screens due to glare from:

Sunlight / Electric Lights / Neither Both / N/A

25) Are there areas within the classroom which are under or over lit?

Underlit / Over lit / Even light throughout

26) Do the lighting controls allow sufficient adjustments in the lighting to meet changing teaching scenarios?

No / Yes / No controls (automatic)

27) Teaching is sometimes interrupted by:

Noise from outside / Noise from other rooms / Neither / Both

Please add any further comments and expand on any answers where improvement measures are required.

Appendix C Initial Performance Review (Name of School)

1.1. Introduction

1.1.1. The introduction should include a description of the School covering the following information as a minimum:

- a) Brief description of the Building (location, floor area, layout, storeys, special facilities etc.). [PM_10]
- b) Date the School was opened. [PM_10]
- c) Number of students. [PM_10]
- d) Name of Contractor. [PM_10]
- e) Name of Architect. [PM_10]
- f) Name of M&E designer. [PM_10]
- g) Facilities management arrangements (in-house or outsourced). [PM_10]
- h) Date of the Initial Performance Review. [PM_10]
- i) Name(s) of individual(s) who conducted the review. [PM_10]
- j) Name(s) of facilities staff interviewed. [PM_10]

1.2. Overview of the design

1.2.1. Overview of design

1.2.1.1. This section shall include an overview of the School's design with sufficient detail to allow the reader to understand the main operating principles of the main Building Services as well as the overall design strategy for energy management. [PM_40_20_26]

1.2.1.2. Most of this information is also found in the building logbook. [PM_70_85_60]

1.2.1.3. Each building service shall be provided with its own sub-heading. Any design targets for the systems should be stated. [PM_40_30_27]

1.2.2. Heating

1.2.2.1. Details of the heating system shall include the operating hours, temperature set points, fuel types, an overview of the local controls and distribution method for heat i.e., via hot water or warm air. [PM_40_20_38]

1.2.2.2. Where there are multiple heating systems such as a biomass boiler and supplementary gas boiler, the interaction between these systems shall be described. [PM_40_20_38]

1.2.3. Lighting

1.2.3.1. Details of the lighting shall cover the type of lamps used, whether they have automatic controls and the level of controls available to teachers in the individual classrooms. [PM_40_20_47]

1.2.3.2. Details shall also be provided regarding how the rooms have been designed to utilise daylight. [PM_40_20_21]

1.2.4. Ventilation

1.2.4.1. Details of the type of ventilation and the controls available to teachers shall be described. [PM_40_20_94]

1.2.4.2. Areas with specific ventilation needs such as kitchen, changing rooms and sports halls shall be noted. [PM_40_20_94]

1.2.4.3. The design maximum CO₂ levels shall also be stated. [PM_40_20_94]

1.2.5. Cooling

1.2.5.1. If cooling is provided, the reason for its use shall be explained. [PM_40_20_38]

1.2.5.2. The details of the controls shall include information on whether it is possible for the heating and cooling systems to be operating at the same time. [PM_40_20_38]

1.2.6. BMS Controls

1.2.6.1. A list of all the systems that are connected to the BMS shall be provided, along with the level of control provided over them. [PM_40_30_52]

1.2.6.2. For example, the BMS may only provide information on whether plant is running or not for some systems, whereas for others it may provide full control including changing of set-points. [PM_40_30_52]

1.2.7. Other major systems (including renewables)

1.2.7.1. Any system which has a significant impact on the building's performance shall be noted. [PM_40_20_26]

1.3. Issues with the Building

1.3.1. This section shall be used to provide information on any issues with the building performance that affect energy consumption, facilities management and building user comfort. [PM_80_10_60]

1.3.2. The walk around tour of the Building shall be undertaken with a member of the facilities staff in order to view all the systems in operation. [PM_10_20_82]

1.3.3. It shall be illustrated with photographs taken during the site visit walk around. [PM_10_20_82]

1.3.4. Wherever possible the root cause of the issues shall be described. [PM_80_10_60]

1.4. Initial Energy and Utility consumption

1.4.1. A brief overview shall be provided of the energy monitoring systems in place and the process required to extract the data from them. For example, it shall be possible to download the meter readings in an easily readable format. [PM_40_20_26]

1.4.2. The ease of investigating energy consumption trends over time shall be stated. For example, is there a computer interface that displays energy consumption in a graphical format on the BMS that the School uses regularly? [PM_40_20_26]

1.4.3. The initial energy and utility data shall be recorded here. As a minimum the following information shall be presented:

- a) Utility being monitored (e.g., gas, electricity etc.). [PM_10_20]
- b) Meter ID. [PM_10_20]
- c) Consumption since start of building occupation until present day. [PM_10_20]
- d) Average consumption per day. [PM_10_20]
- e) Average out of hours consumption per day. [PM_10_20]

1.4.4. A brief description of the energy monitoring process used by the School shall be provided. [PM_10_20]

1.4.5. It shall provide details on who has overall responsibility for monitoring and managing the energy consumption. [PM_10_20]

1.4.6. The energy total consumptions since the start of the occupation, as recorded on the BMS system, shall be extracted and the results shown by completing the table below. [PM_10_20_82]

Utility	Total consumption since start of occupation as recorded by the BMS on date of initial BPE review	Average daily consumption based on number of days since opening	Energy used Kwhr/m²/day based on GIFA m²	Typical benchmark Kwhr/m²/annum from CIBSE TM46 2008	Design energy target from DfE energy efficiency guide 2014	Contractors' proposals as shown in BRUKL, Kwhr/m²/annum	Actual energy used, kwhr/m²/annum
Electric	Kwhr	Kwhr	Kwhr/m ² /day	40	32	N/A	N/A
Gas	m ³	m ³	Kwhr/m ² /day	150 (fossil fuel)	62	N/A	N/A
Water	m ³	m ³	N/A	not shown	2.3l/person/day	N/A	N/A

Table 5 – Energy Consumption

1.5. Facilities staff interview results

1.5.1. The facilities staff interview is based on a multiple-choice format and as such the responses can be presented in the following table. [PM_10]

1.5.2. There shall also be a written summary of the main findings from the interview. [PM_10_20_82]

No.	Questions	Multiple choice answer 1	Multiple choice answer 2	Multiple choice answer 3
1	Do you have any responsibility for the operation and/or maintenance of the Building's heating systems?	Yes	No	N/A
2	The training provided on the operation and/or maintenance of the heating system was	Good	Inadequate	Too complex
3	The heating controls are	Simple to use	Moderately simple to use	Complex to use
4	The level of feedback on the heating system provided by the control system is	Good	Inadequate	Too detailed
5	Issues with the heating systems are	Easy to identify	Slightly difficult to identify	Difficult to identify
6	Maintenance of the heating system is	Easy	Moderately difficult	Difficult
7	Do you have any responsibility for the operation and/or maintenance of the Building's cooling and ventilation systems?	Yes	No	N/A

8	The training provided on the operation and/or maintenance of the cooling and ventilation systems was	Good	Inadequate	Too complex
9	The cooling and ventilation controls are	Simple to use	Moderately simple to use	Complex to use
10	The level of feedback on the cooling and ventilation systems provided by the control system is	Good	Inadequate	Too detailed
11	Issues with the cooling and ventilation systems are	Easy to identify	Slightly difficult to identify	Difficult to identify
12	Maintenance of the cooling and ventilation systems is	Easy	Moderately difficult	Difficult
13	Do you have any responsibility for the operation and/or maintenance of the Building's lighting?	Yes	No	N/A
14	The training provided on the operation and/or maintenance of the lighting/shading/blinds systems was	Good	Inadequate	Too complex
15	The lighting/shading/blind controls are	Simple to use	Moderately simple to use	Complex to use
16	Access to the light fittings for cleaning, replacement and maintenance is	Easy	Moderately difficult	Difficult
17	Using the metering system to compare energy consumption over the weekend with the weekday consumption is	Easy	Difficult	Not possible

18	Using the metering system to compare the energy consumption of this week with last week is	Easy	Difficult	Not possible
19	The training provided for monitoring and reporting the school's water and energy use was	Good	Inadequate	Too complex
20	In terms of helping to understand, operate and manage the School, the Contractor's Aftercare Service was	Full and complete	Partly complete	Inadequate
21	Cleaning the school building is	Completely straight forward	Partly straight forward	Difficult

Table 6 – Example Results Format

1.5.3. If any additional questions are asked in order to obtain a more detailed understanding of the issues raised, they shall be noted along with the corresponding response. [PM_10_20_82]

1.6. Teaching staff survey results

1.6.1. A summary of the main findings in all areas shall be provided and any trends in poor building performance should be highlighted. [PM_10_20_82]

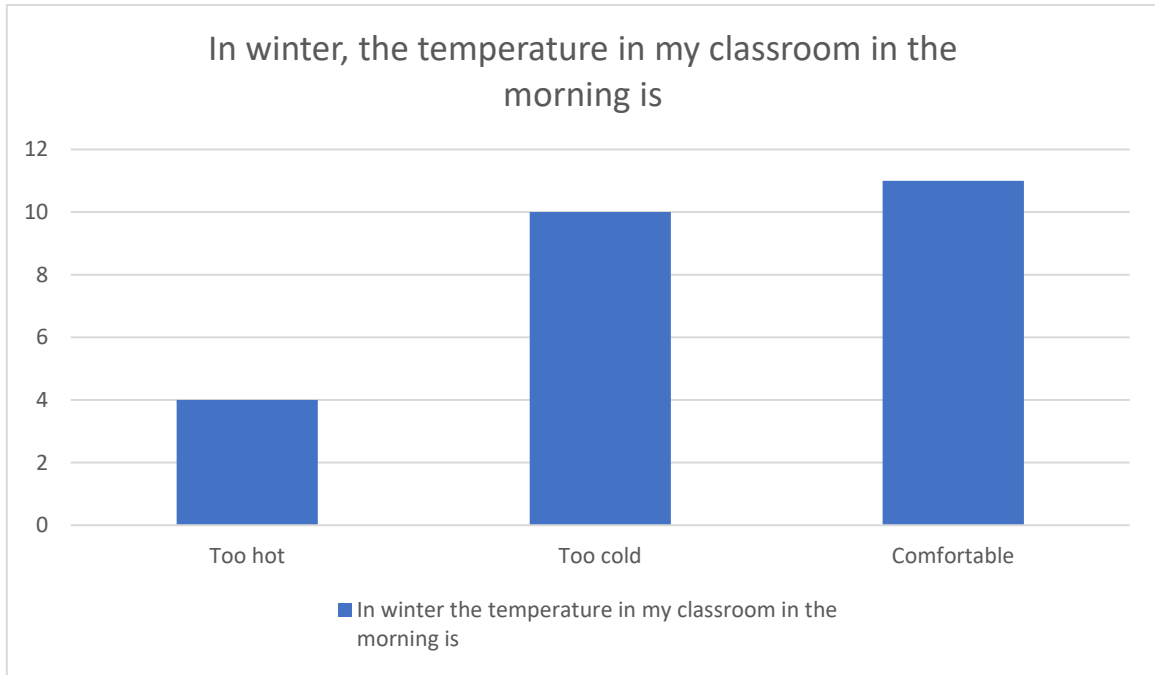
1.6.2. It is important when interpreting the staff survey results to look at the broad trends in the opinions rather than focusing on single points from individuals. [PM_10_20_82]

1.6.3. In addition to the summary, the responses to the individual questions shall be presented in a graphical format. [PM_10_20_82]

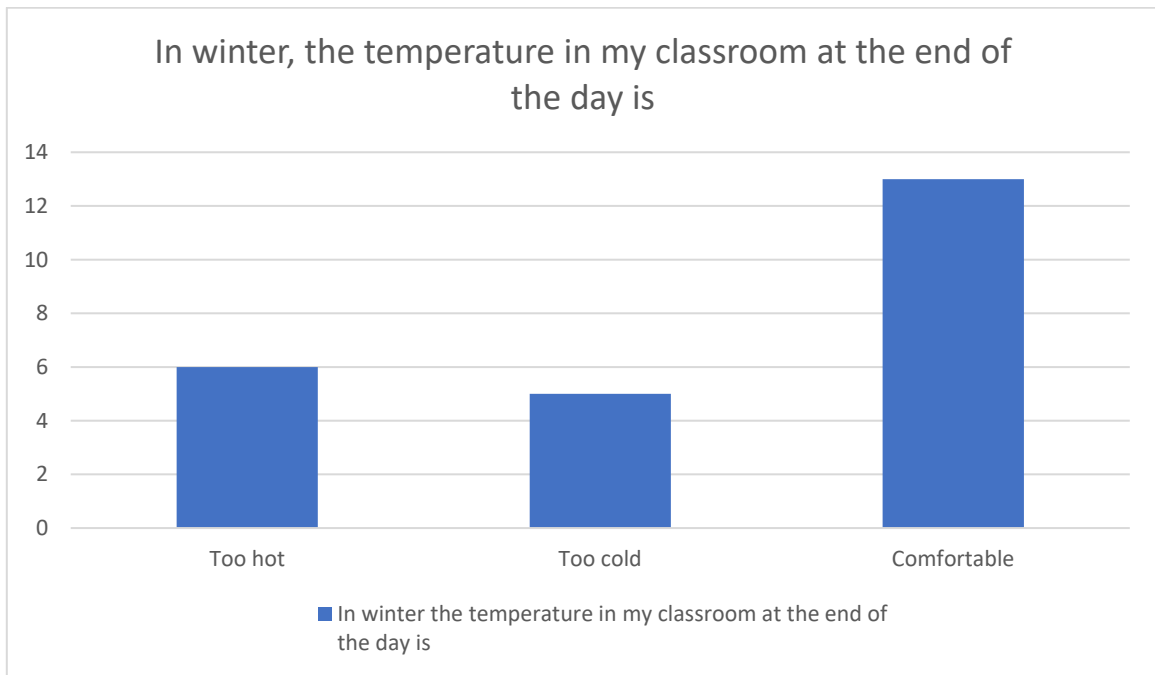
1.6.4. A spreadsheet answer template is available to assist with this process. [PM_10]

1.6.5. Although the questions are multiple choice there are spaces on the answer sheet for the respondents to provide further details if required. [PM_10]

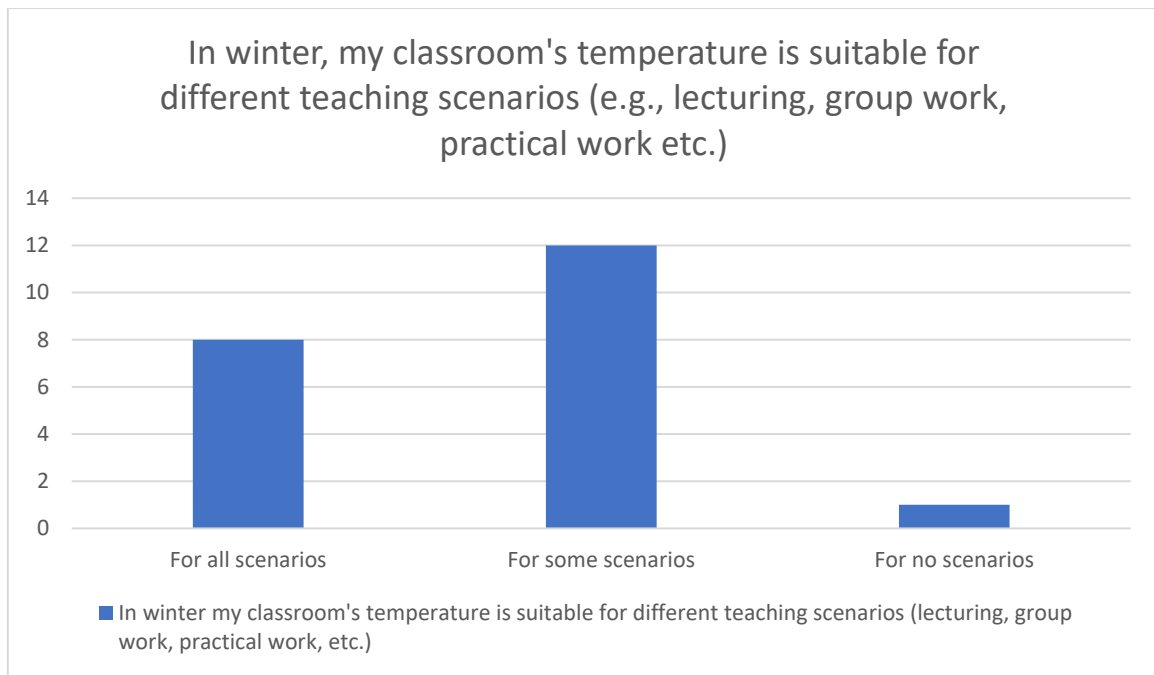
1.6.6. These additional responses shall be reported below the graphs. As shown in the following examples. [PM_10_20_82]



Question 1 - Winter morning temperature in the classroom



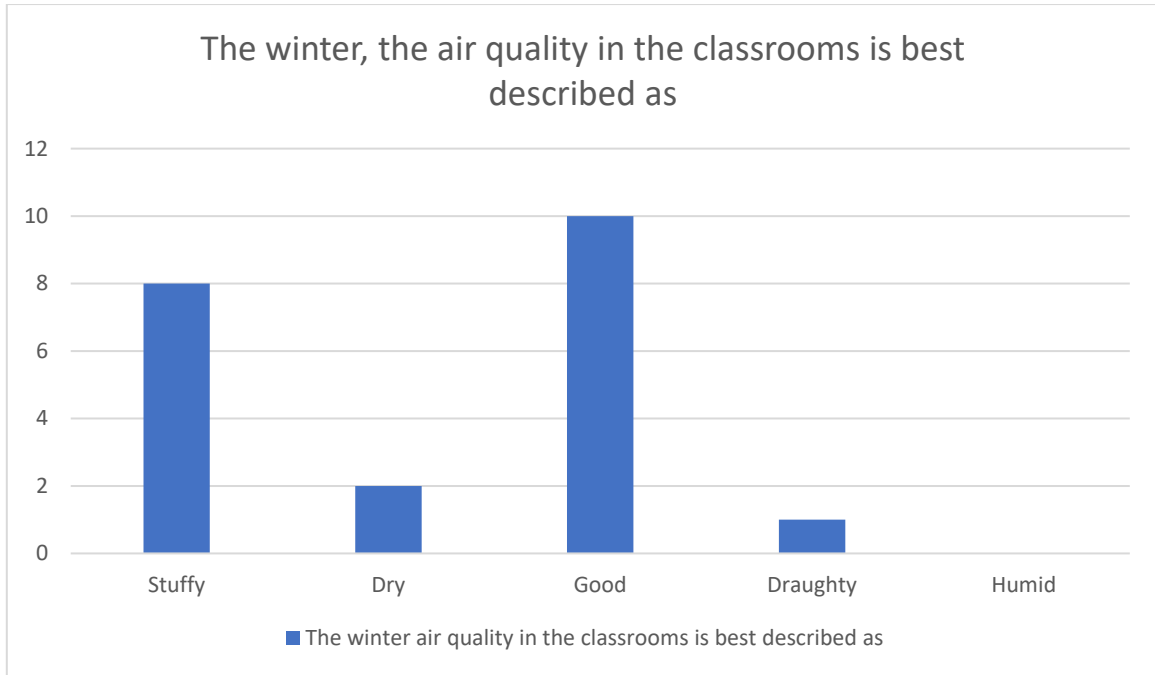
Question 2 - Winter end of the day temperature in the classroom



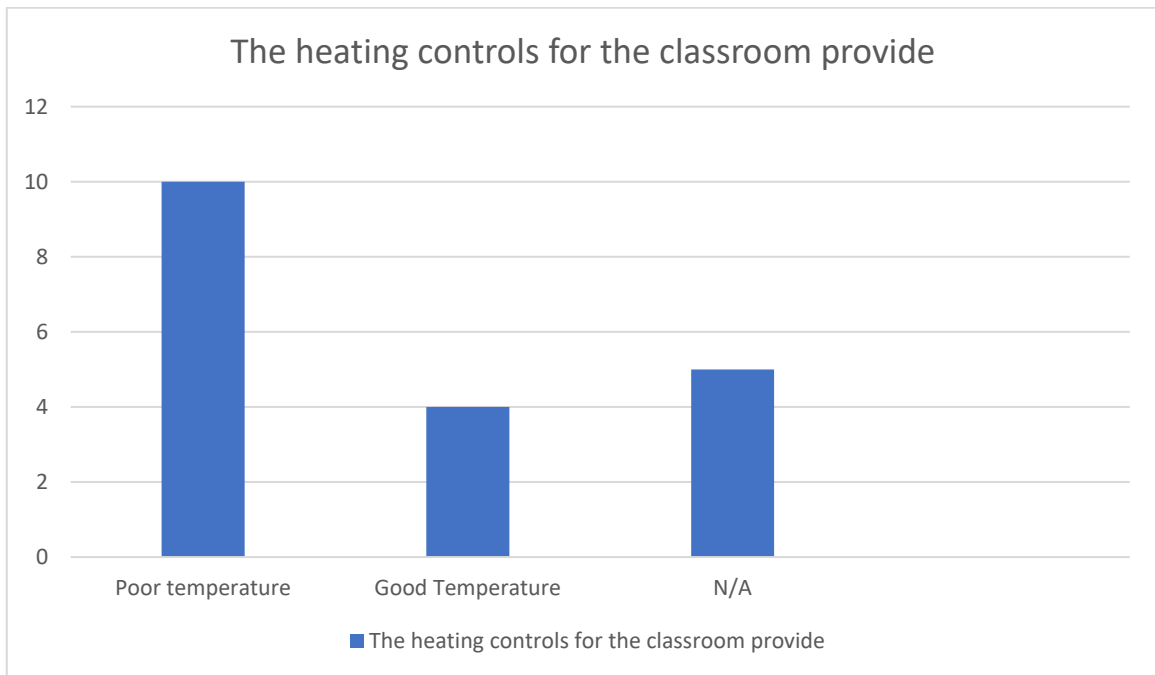
Question 3 - Winter classroom temperature suitable for different teaching scenarios

“Towards the end of the day students are drained and lack energy and motivation.”

“The room is hot and stuffy.”



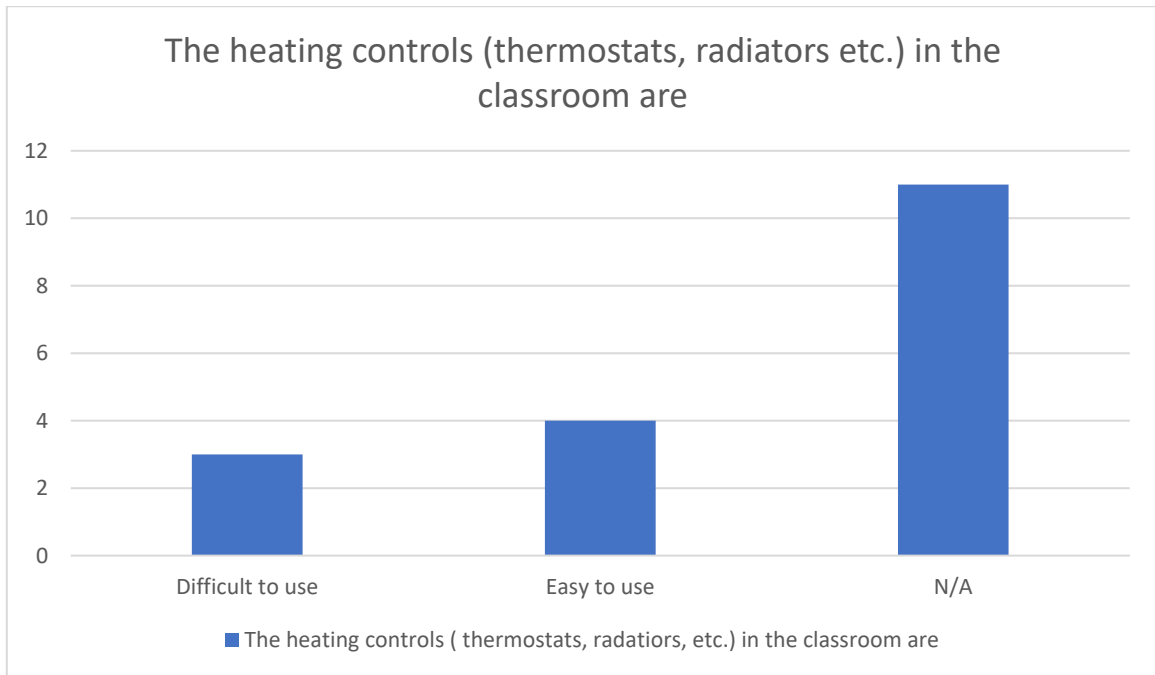
Question 4 - Winter air quality in the classroom



Question 5 - Heating controls for the classroom

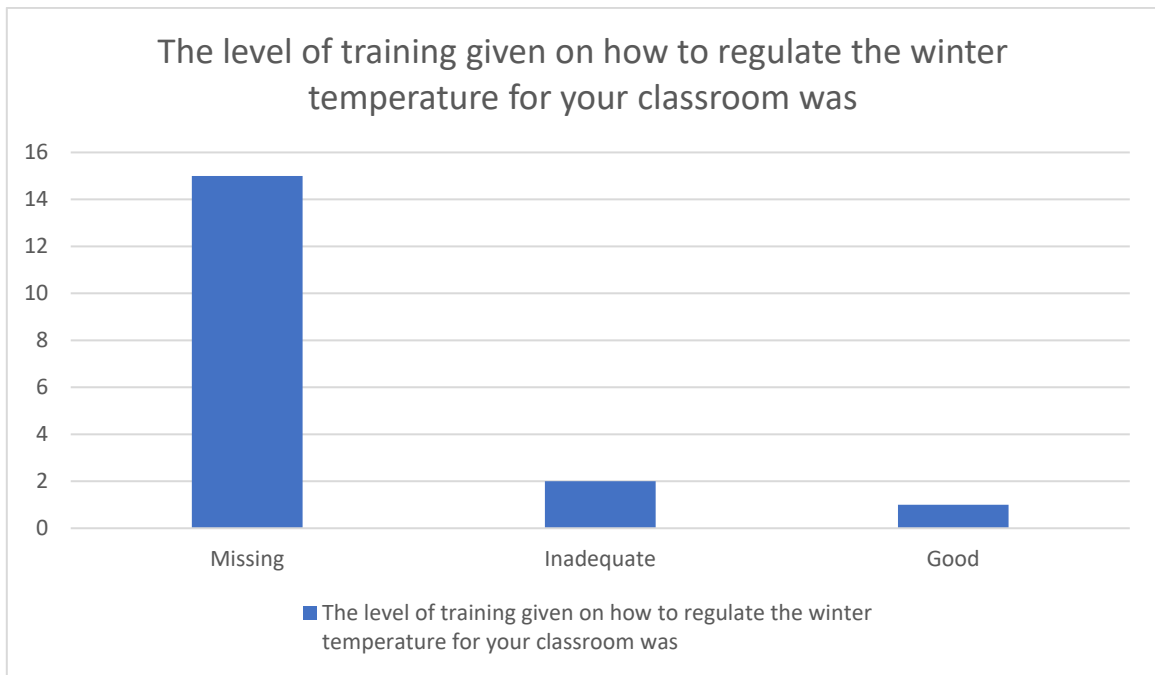
“The temperature stays the same even if the controls are adjusted.”

“The thermostat has no effect.”

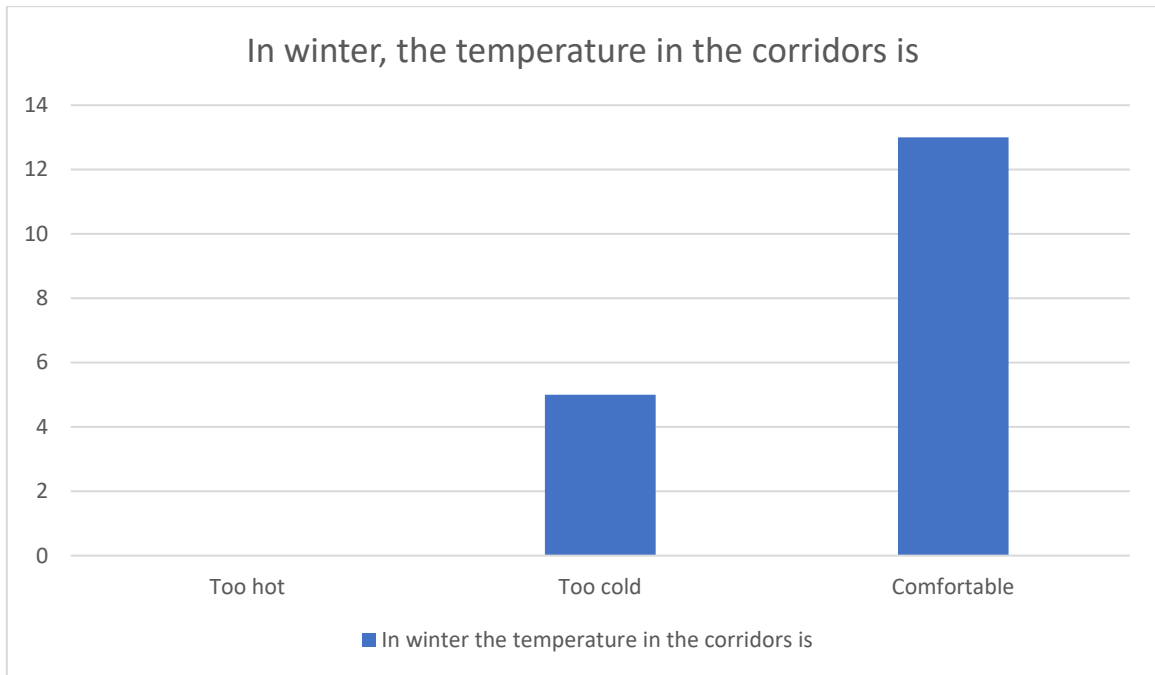


Question 6 - Heating controls in the classroom

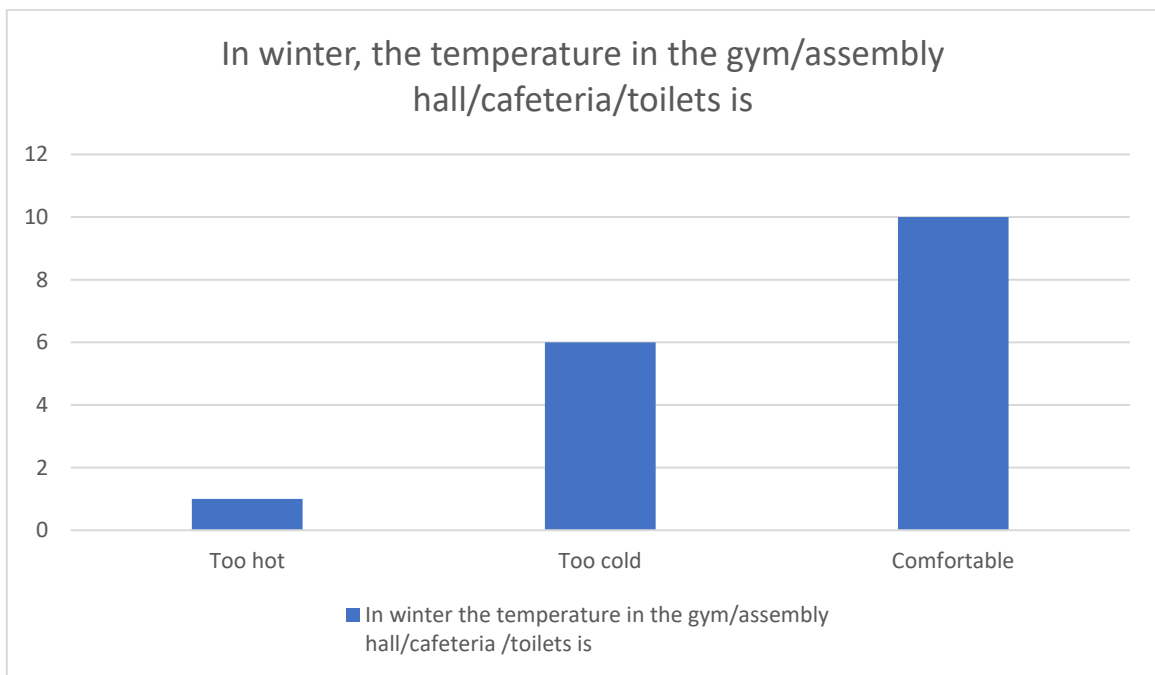
“The controls make no difference to the temperature.”



Question 7 - Level of training given on how to regulate the winter temperature in the classroom



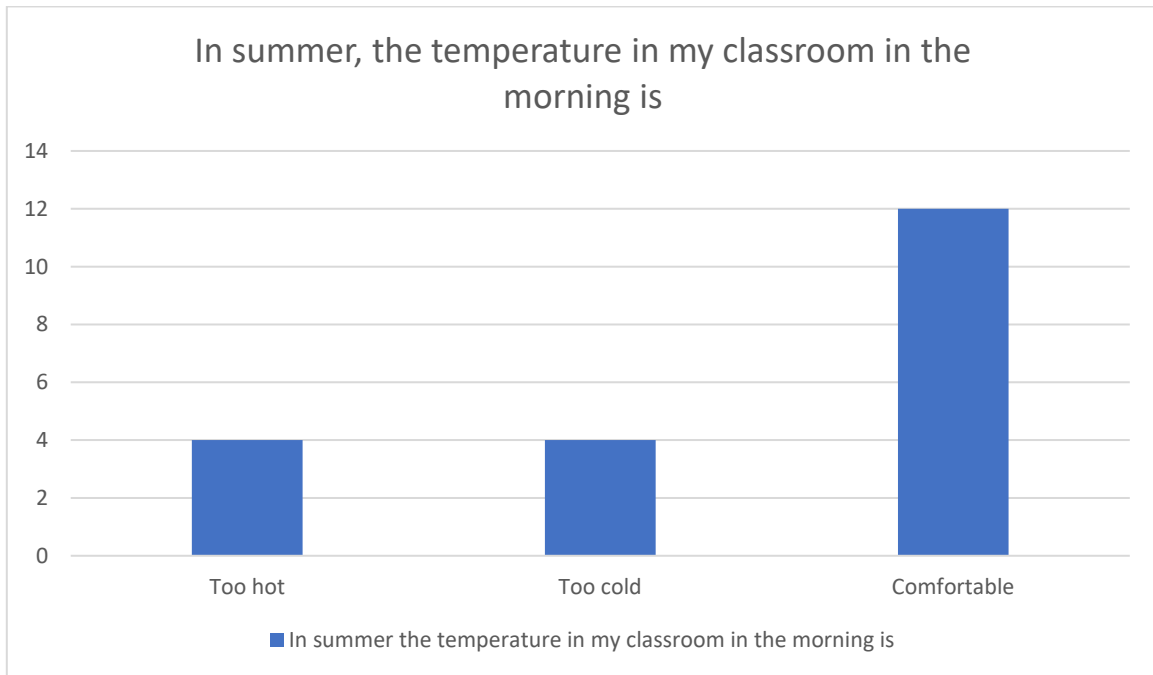
Question 8 - Winter temperature in the corridors



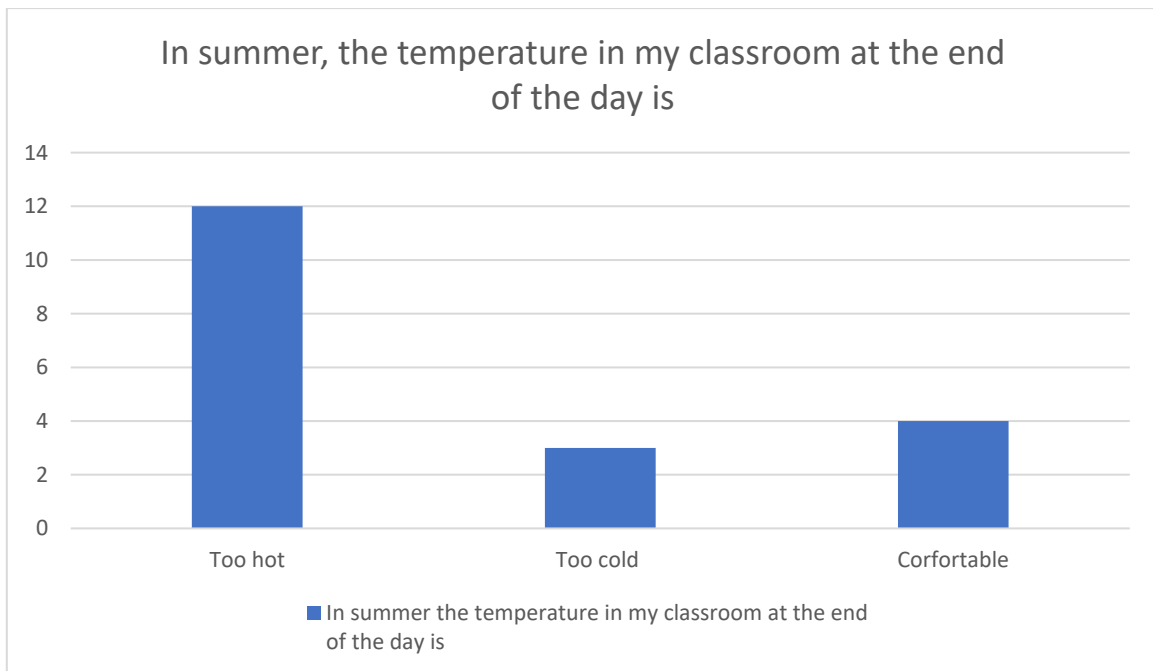
Question 9 - Winter temperature in the gym/assembly hall/cafe/teria/toilets

“Always very warm.”

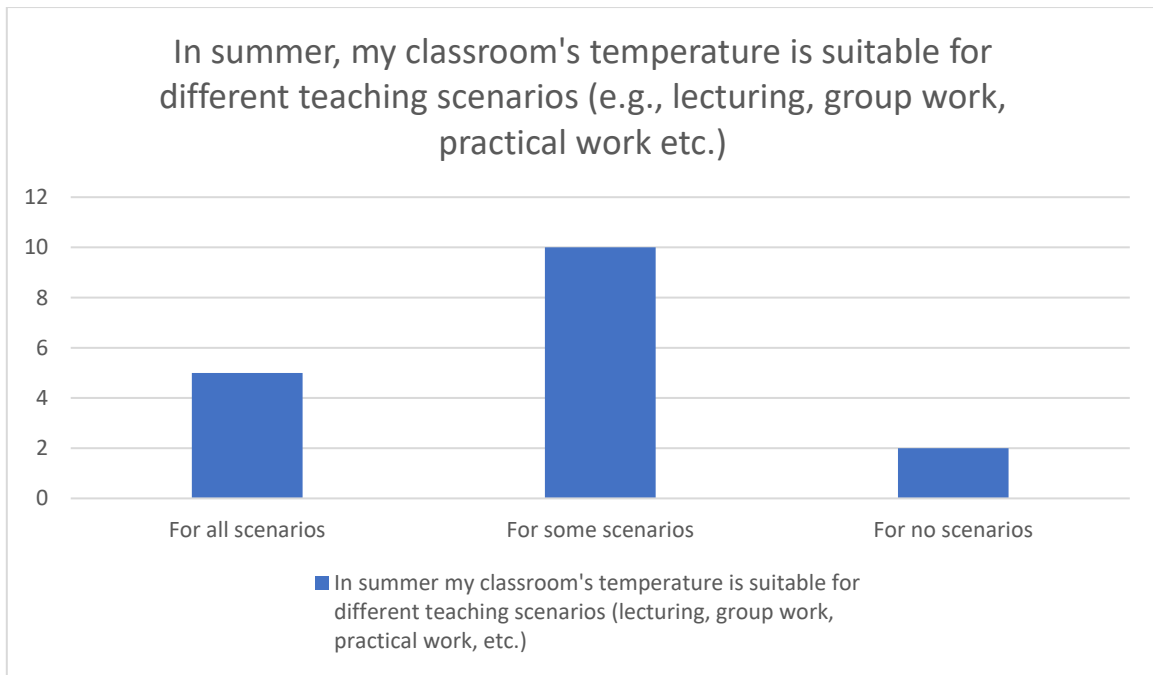
“The sports hall is very warm.”



Question 10 - Summer morning temperature in the classroom



Question 11 - Summer end of the day temperature in the classroom



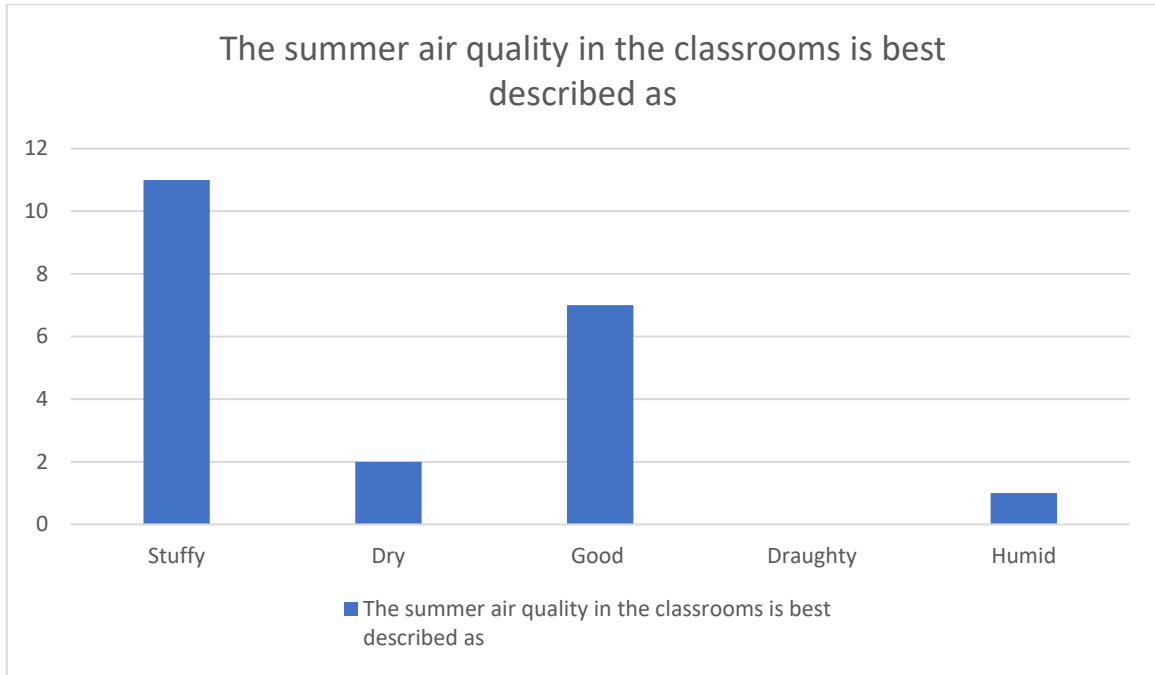
Question 12 - Summer classroom temperature suitable for different teaching scenarios

"We carry out daily duties, however temperature and environment make these difficult and exhausting."

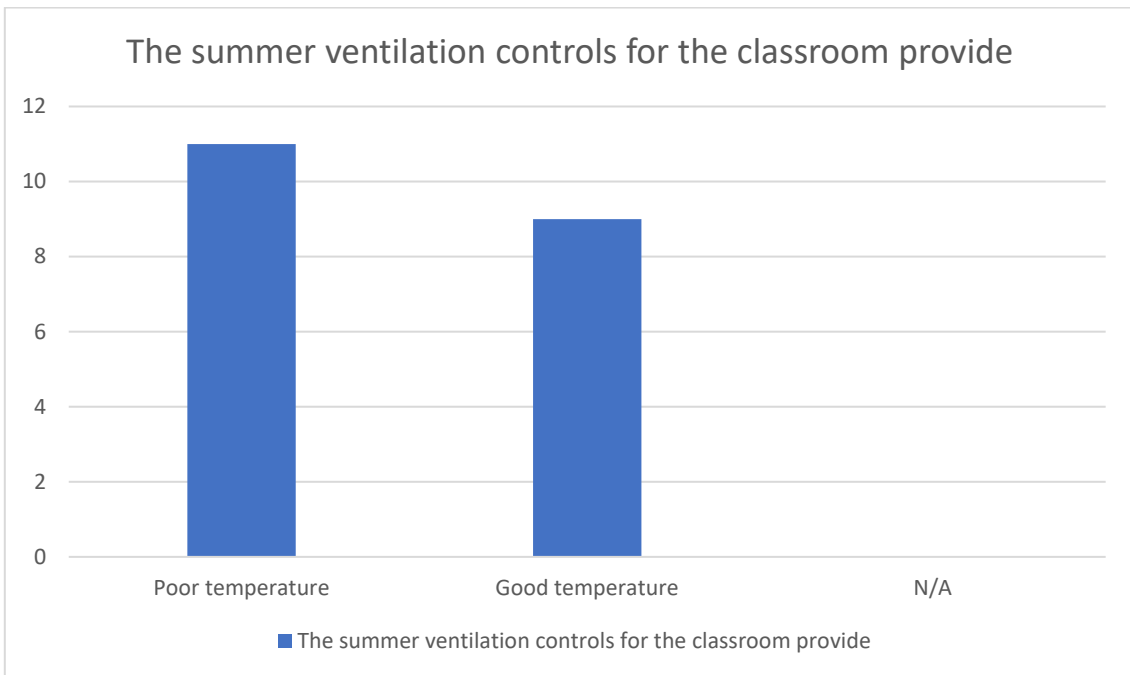
"Leave the unit feeling tired and unwell during the summer months."

"No fresh air circulation."

"Room is very warm and stuffy."

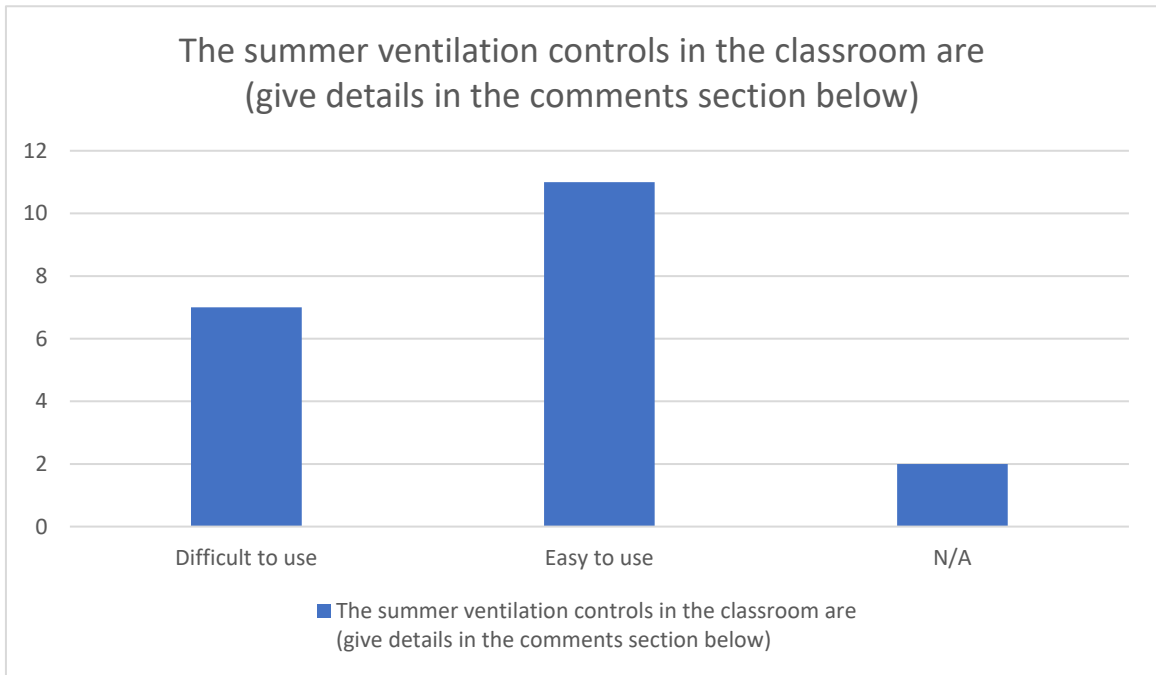


Question 13 - Summer classroom air quality



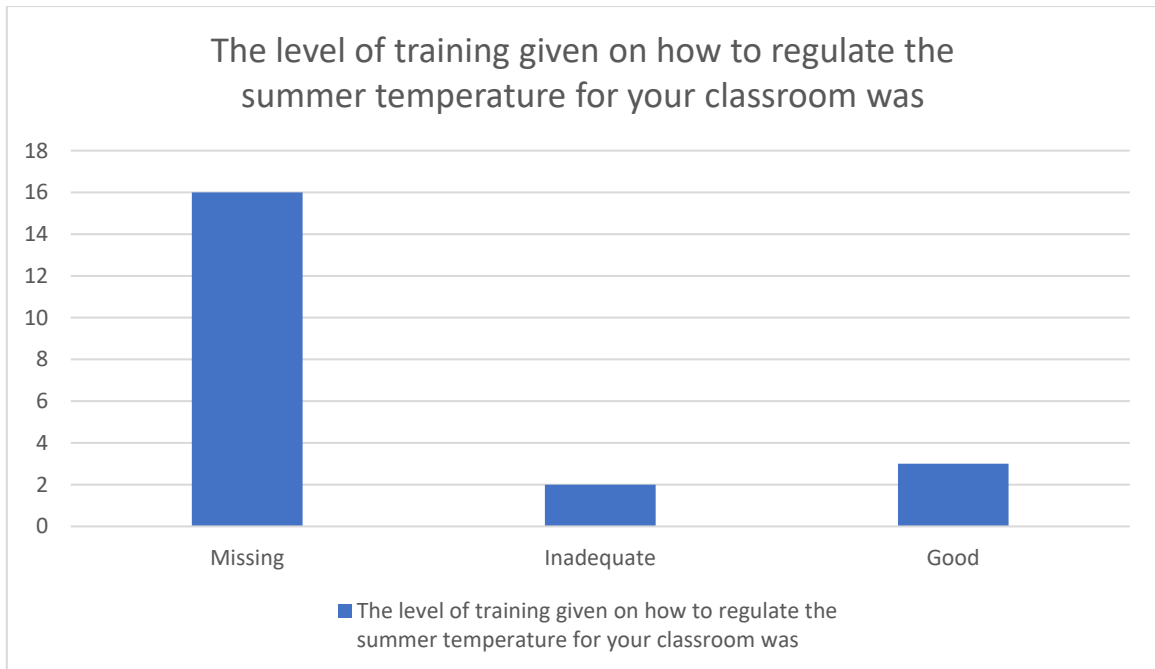
Question 14 - Summer classroom ventilation controls provide

“The air conditioning is set as low as possible.”

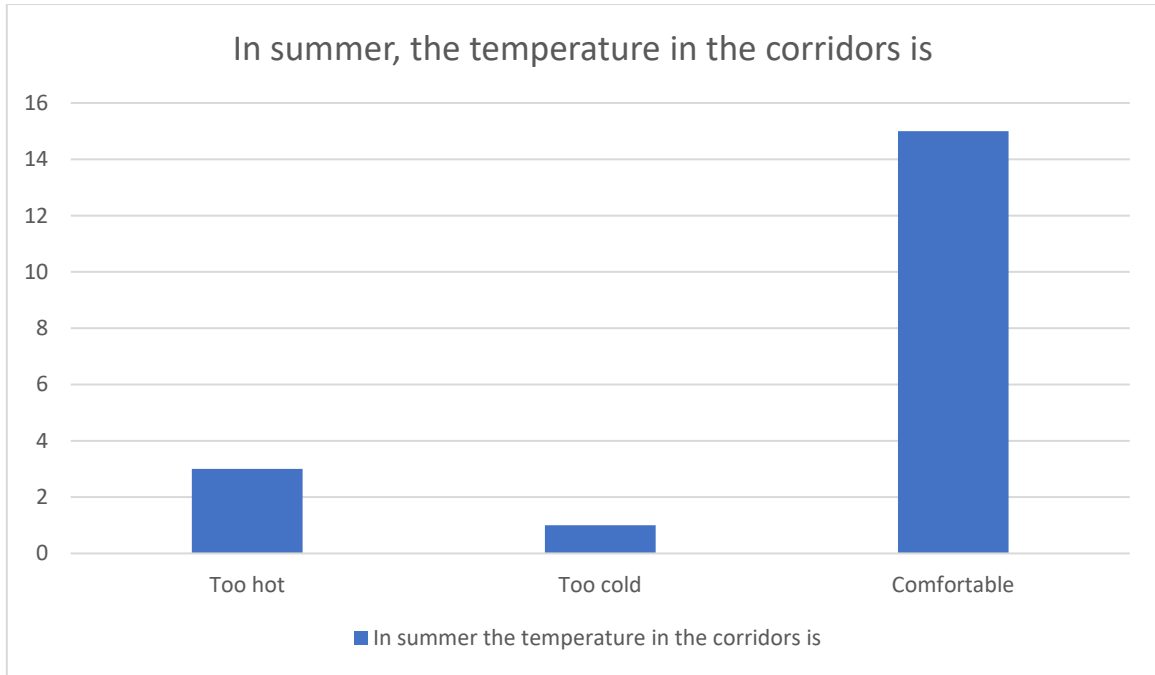


Question 15 - Summer classroom ventilation controls are

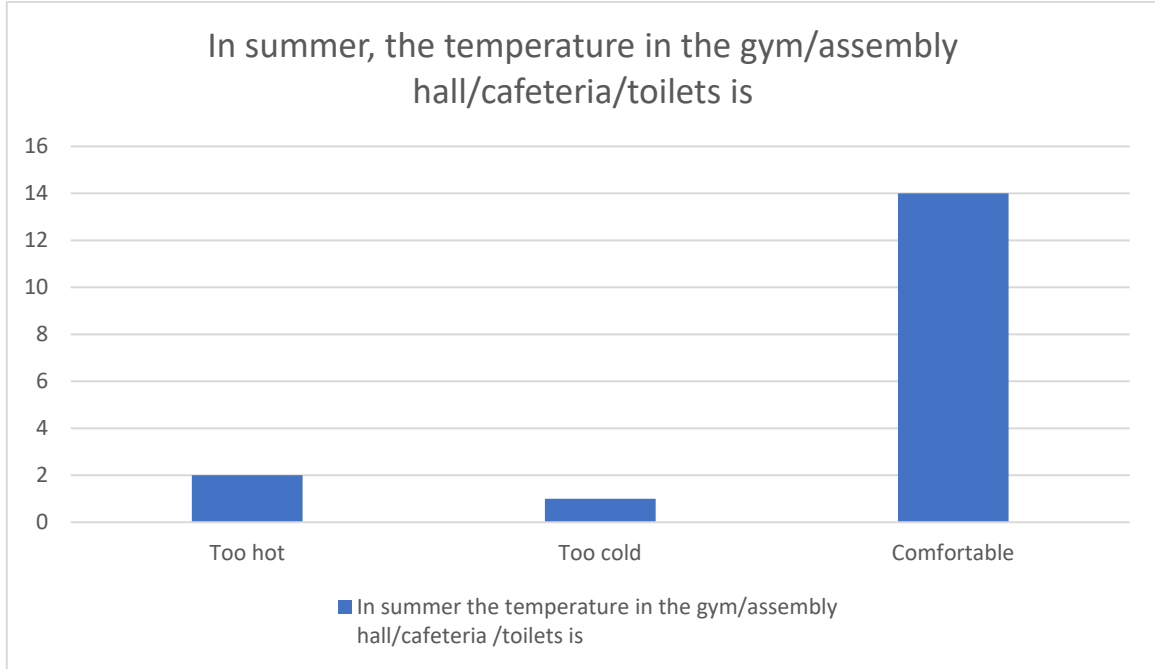
“The controls make no difference.”



Question 16 - Level of training given on how to regulate the summer temperature in the classroom

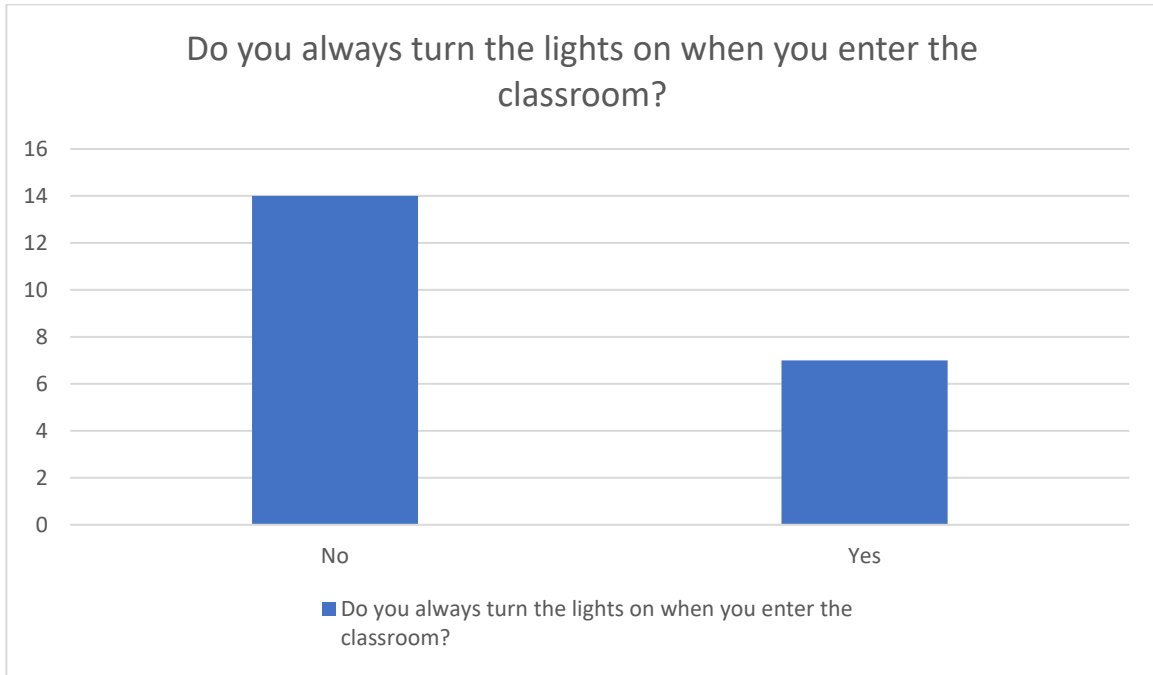


Question 17 - Summer temperature in the corridors

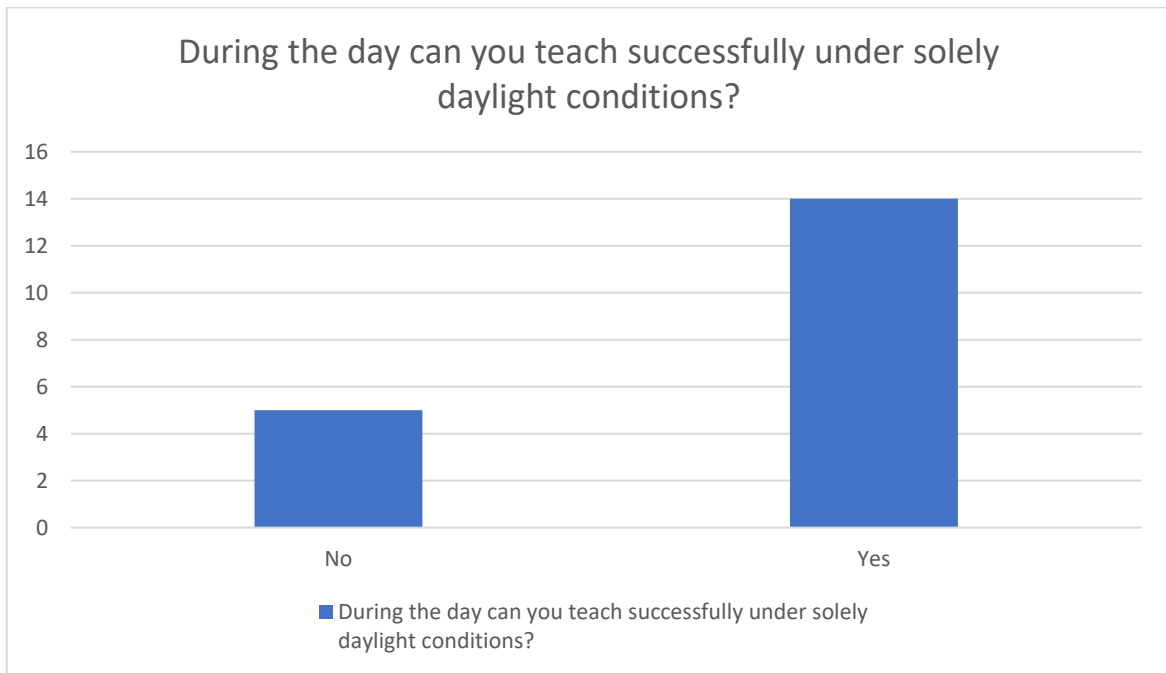


Question 18 - Summer temperature in the gym/assembly/hall/cafe/tertia/toilets

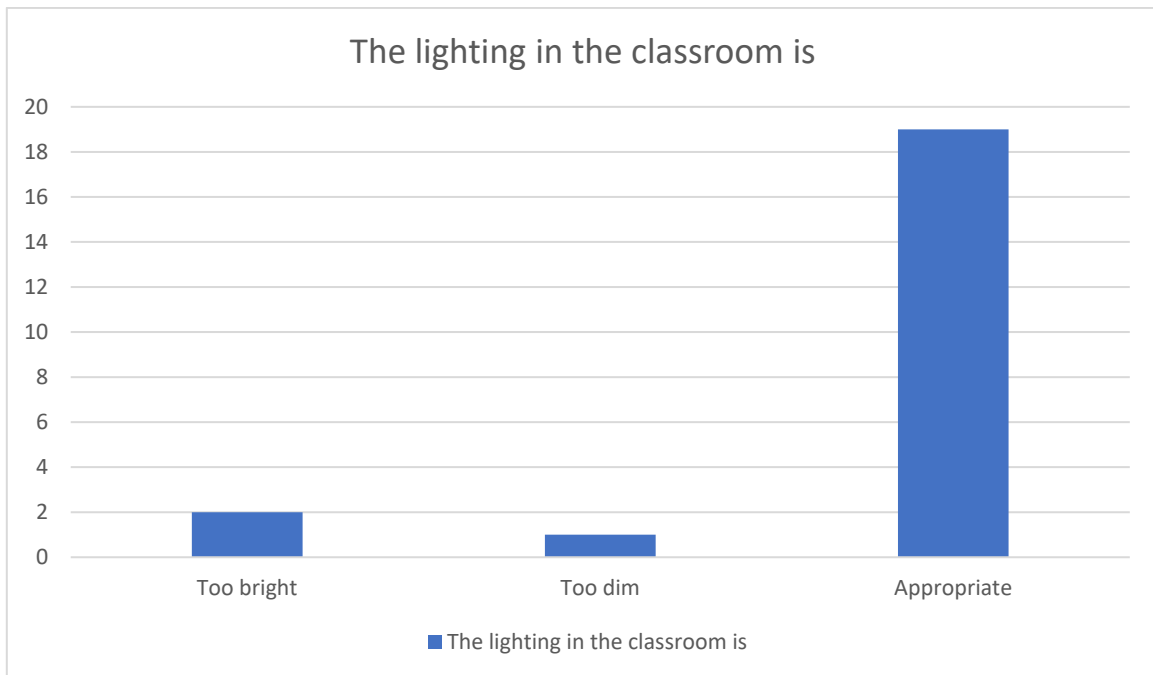
“The temperature varies from 25.4°C to 28.1°C in the summer.”



Question 19 - Turning on lights when entering the classroom

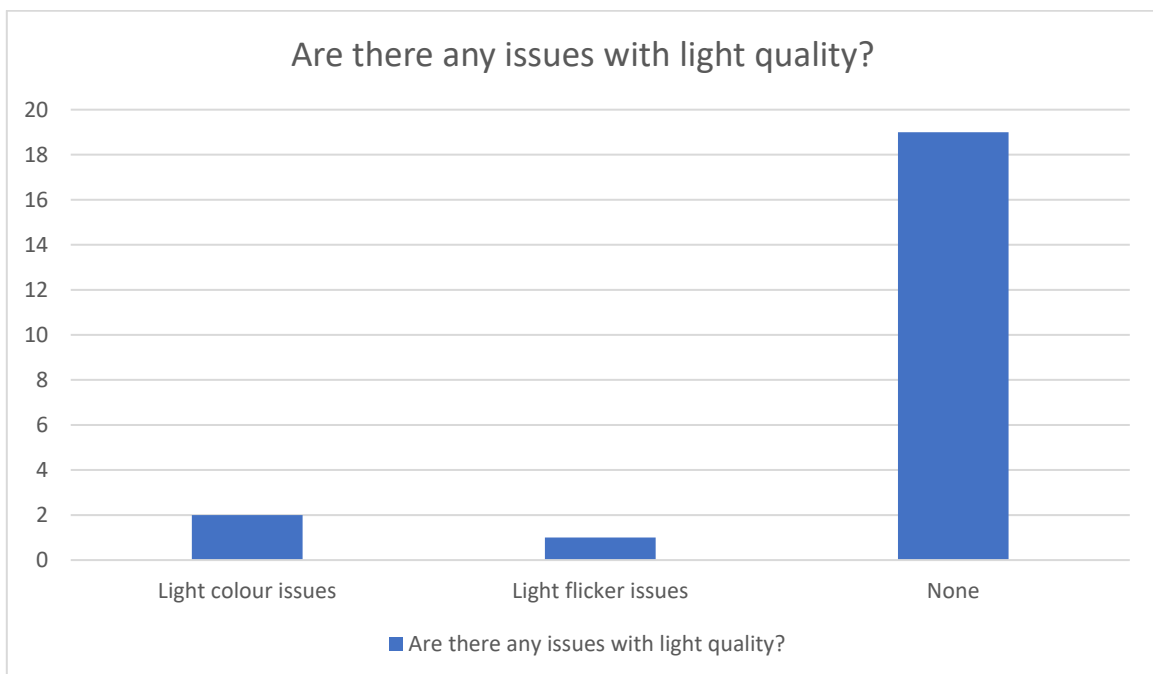


Question 20 - During the day teaching successfully under daylight conditions

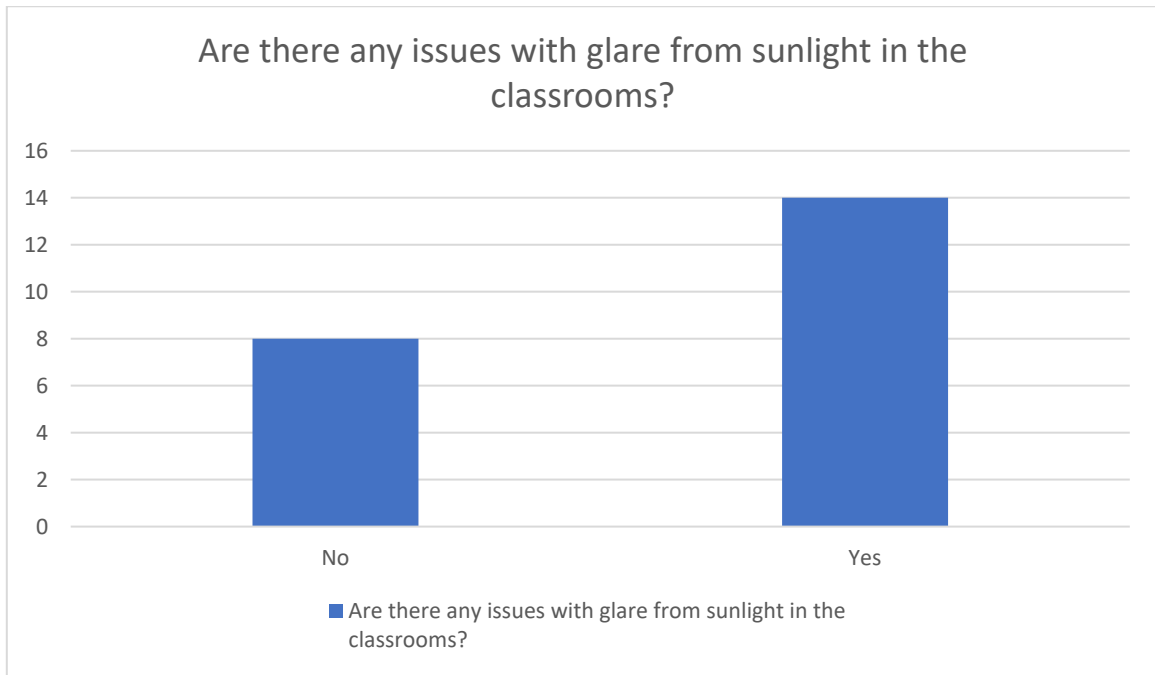


Question 21 - Classroom lighting

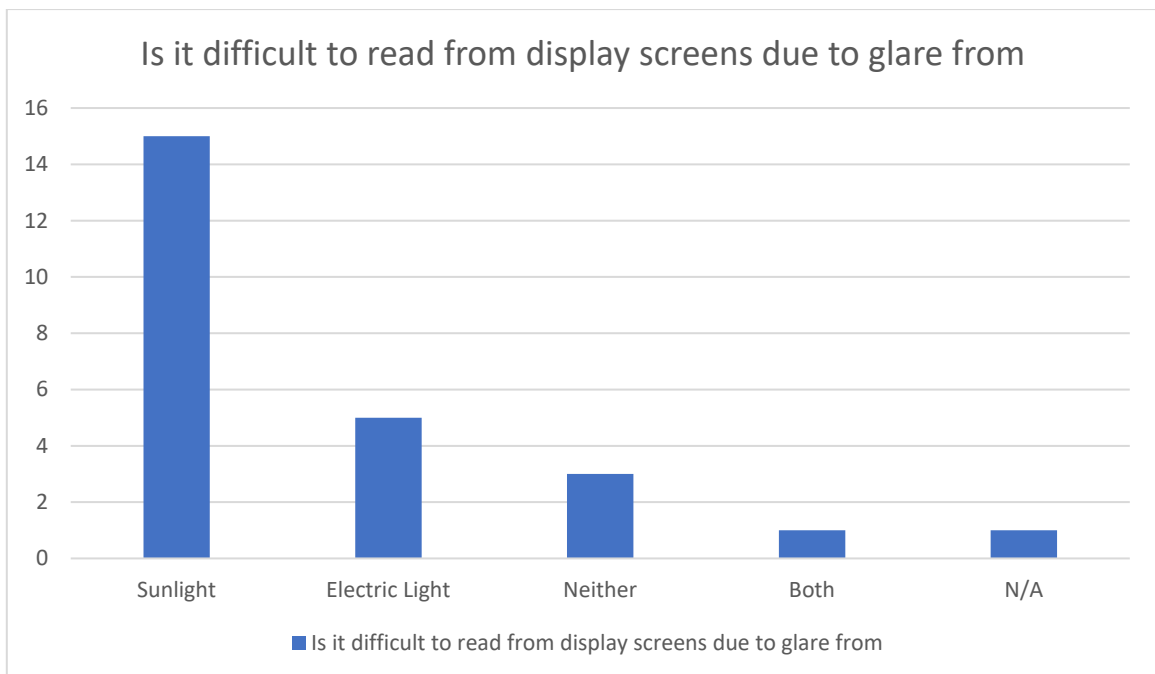
"The lights are ill placed."



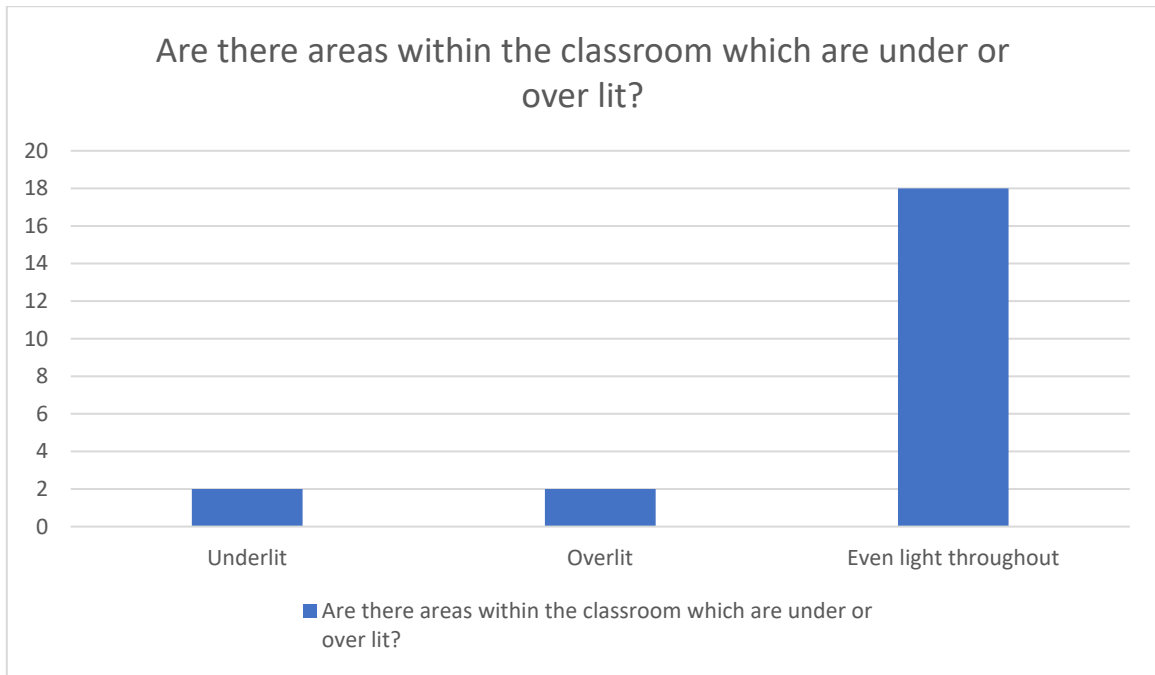
Question 22 - Light quality issues



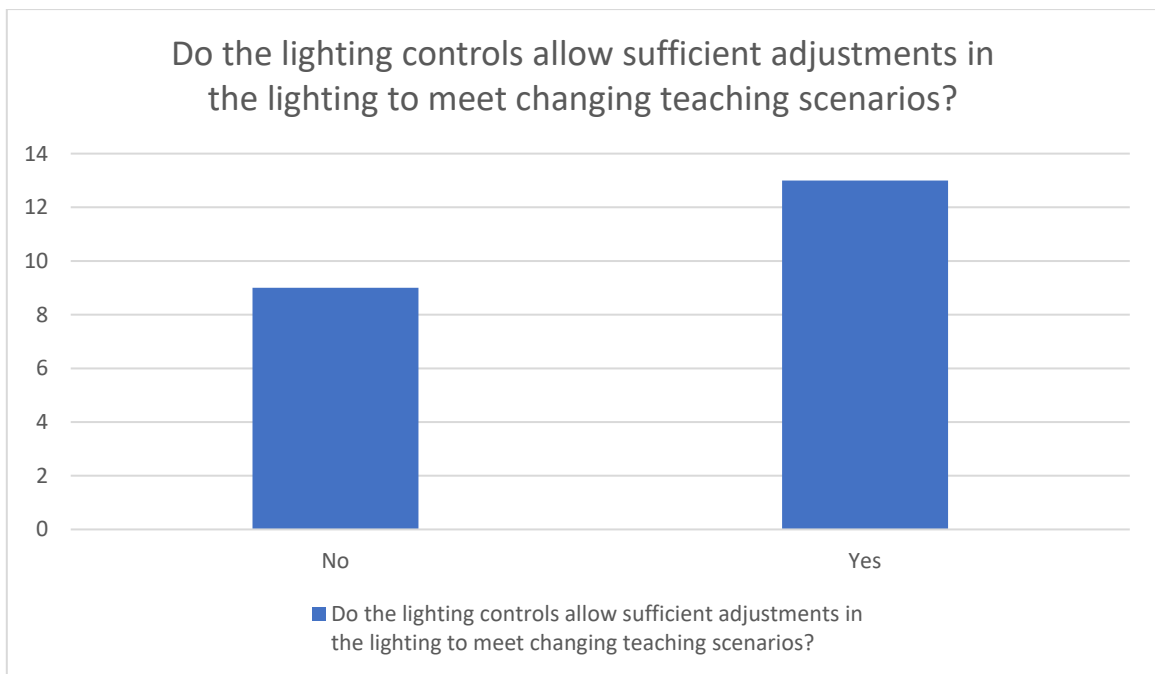
Question 23 - Glare issues from sunlight in the classroom



Question 24 - Difficulty when reading from display screens due to glare

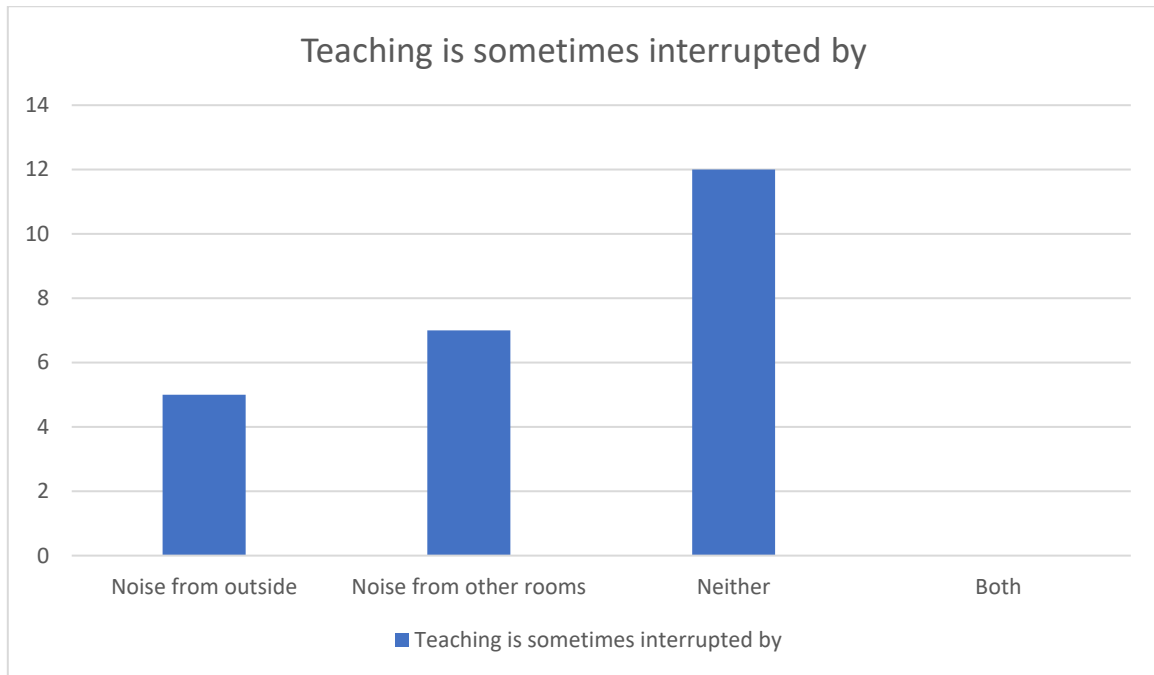


Question 25 - Areas within the classroom that are under or over lit



Question 26 - Lighting controls allowing sufficient adjustments in the lighting to meet changing teaching scenarios

“There are light and dark areas within the room.”



Question 27 - Teaching interruptions

General comments:

“Gets too hot in the office and doors have to be propped open.”

“The office gets hot and stuffy. When the sun shines on the side of the building it gets very hot.”

“Door is always open to get air circulating. Staff room is noisy.”

“Fire door needs to be open to cool the office.”

“Nothing ever changes despite contractors trying.”

“Room is always warm and stuffy. We only have half the lights on and need to keep the student access hatch open all day which is noisy.”

1.7. Conclusion

1.7.1. The main areas of both good and bad performance for the Building are to be summarised in this section. [PM_80_10_60]

1.7.2. If there are any definite actions which need to be taken, they shall also be listed. [PM_60_30_05]

1.7.3. A simple table showing the outcome of the review ranking the issues raised in order of significance shall be provided along with proposed action plan to rectify any issues. [PM_10_20_82]

Issue No.	School or general	Issue	Explanation	Issue Owner	Lead action required by
1	general	Training	Reinforcing training on ventilation controls will assist in reducing overheating	Contractor/ School	Contractor
2	school	Teaching staff questionnaires	17 returned from school: Winter temperature – generally good, some draught issues due to main entrance doors. Noise/acoustics generally good but some reports of noise transmission from adjacent rooms and ventilation units (rooms 2027, 2026). Summer temperature – generally good but some rooms too hot (textiles room, general office). All would benefit from training on what controls are available within classrooms. Air quality – generally good, some reports of stuffy/some draughts, some Bunsen burner issues (room 2026)	Contractor	Contractor

			Lighting – generally considered satisfactory.		
3	general	Energy consumption is good	Sub-meter calibration against utility billing data and ensuring that all sub-meters are recording data would help the school in managing their energy consumption.	Contractor	Contractor
4	N/A	N/A	N/A	N/A	N/A
5 etc	N/A	N/A	N/A	N/A	N/A

Table 7 – Example Review Outcome

1.7.4. Develop the action plan from the initial BPE review showing the proposed programme for all items and implement in preparation for the final BPE review at 12 months after occupation. [PM_10_20_82]

Appendix D Final Performance Evaluation Report Template

1. Final Performance Review (Name of School)

1.1. Introduction

1.1.1. This section shall be an update of the equivalent section in the Initial Performance Review document. [PM_10]

1.1.2. The introduction shall include a description of the School which covers at least the following information.

- a) Brief description of the Building (location, floor area, layout, storeys, special facilities etc.). [PM_10]
- b) Date the School was opened. [PM_10]
- c) Number of students. [PM_10]
- d) Name of Contractor. [PM_10]
- e) Name of Architect. [PM_10]
- f) Name of M&E designer. [PM_10]
- g) Facilities management arrangements (in house or outsourced). [PM_10]
- h) Date of the Initial Performance Review. [PM_10]
- i) Name(s) of individual(s) who conducted the review. [PM_10]
- j) Name(s) of facilities staff interviewed. [PM_10]
- k) Number of teaching staff who completed the questionnaire. [PM_10]

1.2. Overview of the design

1.2.1. General

1.2.1.1. As with the “Introduction” this section can be drawn from the work done from the Initial Performance Review document, with any changes specifically highlighted. [PM_10]

1.2.1.2. This section shall include an overview of the School’s design with sufficient detail to allow the reader to understand the main operating principles of the main Building Services as well as the overall design strategy for energy management. [PM_40_20_26]

1.2.1.3. Much of this information is often located in the building logbook.
[PM_70_85_60]

1.2.1.4. Each building service shall be provided with its own sub-heading. Any design targets for the systems should be stated. [PM_40_30_27]

1.3. Heating

1.3.1. Details of the heating system shall include the operating hours, temperature set points, fuel types, an overview of the local controls and distribution method for the heat i.e., via hot water or warm air. [PM_40_20_38]

1.3.2. Where there are multiple heating systems, such as a biomass boiler and supplementary gas boiler, the interaction between these systems shall be described. [PM_40_20_38]

1.3.2. Lighting

1.3.2.1. Details of the lighting shall cover the type of lamps used, whether they have automatic controls and the level of controls available to teachers in the individual classrooms. [PM_40_20_47]

1.3.2.2. Details shall also be provided regarding how the rooms have been designed to utilise daylight. [PM_40_20_21]

1.3.3. Ventilation

1.3.3.1. Details of the type of ventilation and the controls available to teachers shall be described. [PM_40_20_94]

1.3.3.2. Areas with specific ventilation needs such as kitchen, changing rooms and sports halls shall be noted. [PM_40_20_94]

1.3.3.3. The design maximum CO₂ levels shall also be stated. [PM_40_20_94]

1.3.4. Cooling

1.3.4.1. If cooling is provided, the reason for its use shall be explained.
[PM_40_20_38]

1.3.4.2. The details of the controls shall include information on whether it is possible for the heating and cooling systems to be operating at the same time.
[PM_40_20_38]

1.3.5. BMS Controls

1.3.5.1. A list of all the systems that are connected to the BMS shall be provided, along with the level of control provided over them. [PM_40_30_52]

1.3.5.2. For example, the BMS may only provide information on whether plant is running or not for some systems, whereas for others it may provide full control including changing of set-points. [PM_40_30_52]

1.3.6. Other major systems (including renewables)

1.3.6.1. Any system which has a significant impact on the building's performance shall be noted. [PM_40_20_26]

2. Issues with the Building

2.1. Issues with the Building

2.1.1. General

2.1.1.1. This section focuses on the issues with the building performance that affect energy consumption, facilities management and building user comfort. [PM_10]

2.1.1.2. It shall be supported by the photographs taken on the site visit. [PM_10_20_82]

2.1.1.3. Wherever possible the root cause of the issues shall be described. [PM_10_20_82]

2.1.1.4. As the Building will have been occupied for some months, a greater number of issues may have emerged. [PM_10]

2.1.1.5. Issues with the ease of maintaining and cleaning the Building shall be noted. [PM_10_20_82]

2.2. Energy and Utility consumption

2.2.1. Description of the energy monitoring systems

2.2.1.1. A brief overview shall be provided of the energy monitoring systems in place and the process required to extract the data from them. [PM_40_20_26]

2.2.1.2. The ease of investigating energy consumption trends over time shall be stated. For example, is there a computer interface that displays energy consumption

in a graphical format; do the School utilise the iSERV energy reports in managing the Building? [PM_10_20_82]

2.2.2. Overview of energy consumption

2.2.2.1. The first year annual energy and utility data should be recorded here. As a minimum the following information should be presented.

- a) Utility being monitored (e.g., gas, electricity etc). [PM_10_20]
- b) Meter ID. [PM_10_20]
- c) Consumption since the start of building occupation until the present time. [PM_10_20]
- d) Average consumption per day. [PM_10_20]
- e) Average out of hours consumption per day. [PM_10_20]

2.2.2.2. A brief description of the energy monitoring process used by the School should be provided including details on who has overall responsibility for monitoring and managing the energy consumption. [PM_10_20_82]

2.2.3. Breakdown of consumption

2.2.3.1. The electricity consumption should be grouped into use type and presented to demonstrate how the energy is consumed as shown in the following chart. [PM_10_20_82]

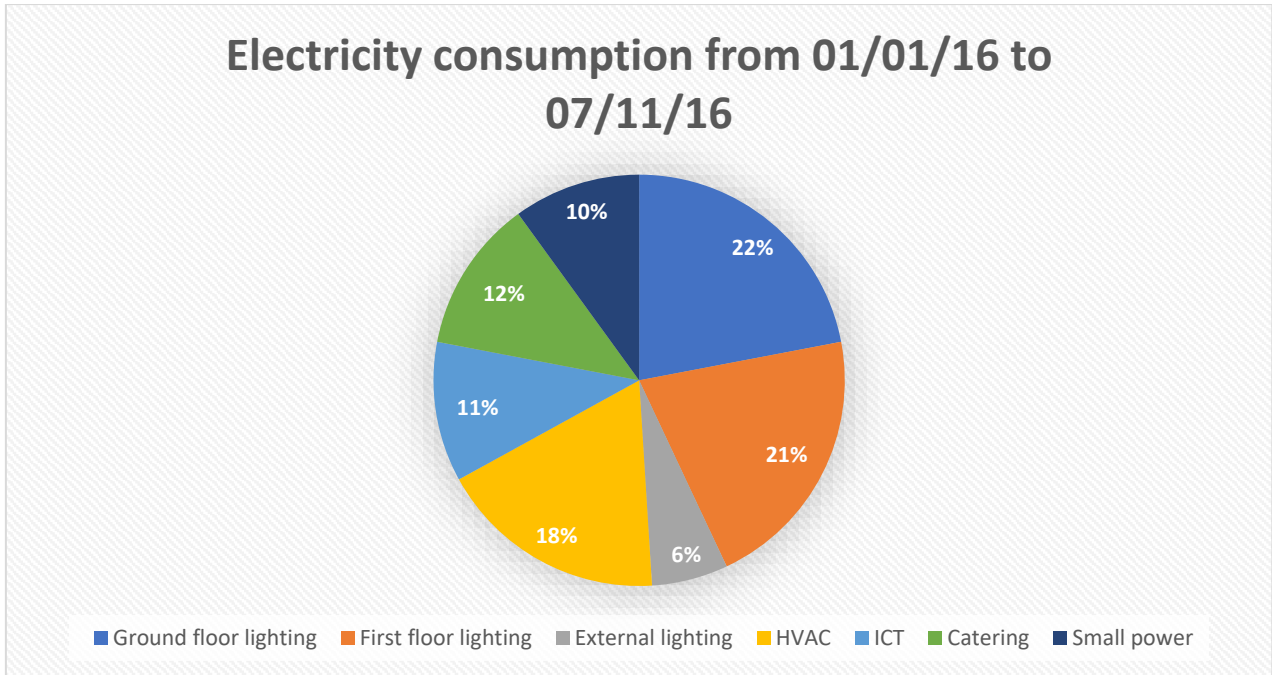


Figure 2 – Electricity consumption from 01/01/2016 to 07/11/2016

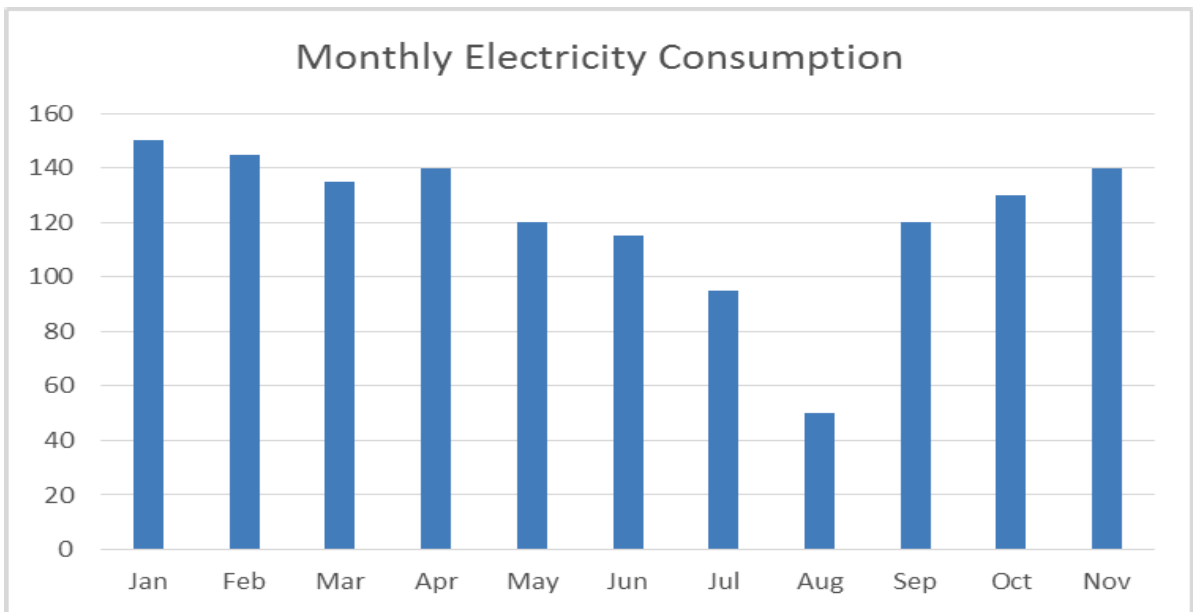


Figure 3 – Monthly Electricity Consumption

2.2.3.2. The monthly totals for the various sub-meters and main meters shall also be shown. Where there are trends observed in the energy consumption, a commentary should be provided describing the likely drivers behind them. [PM_10_20_82]

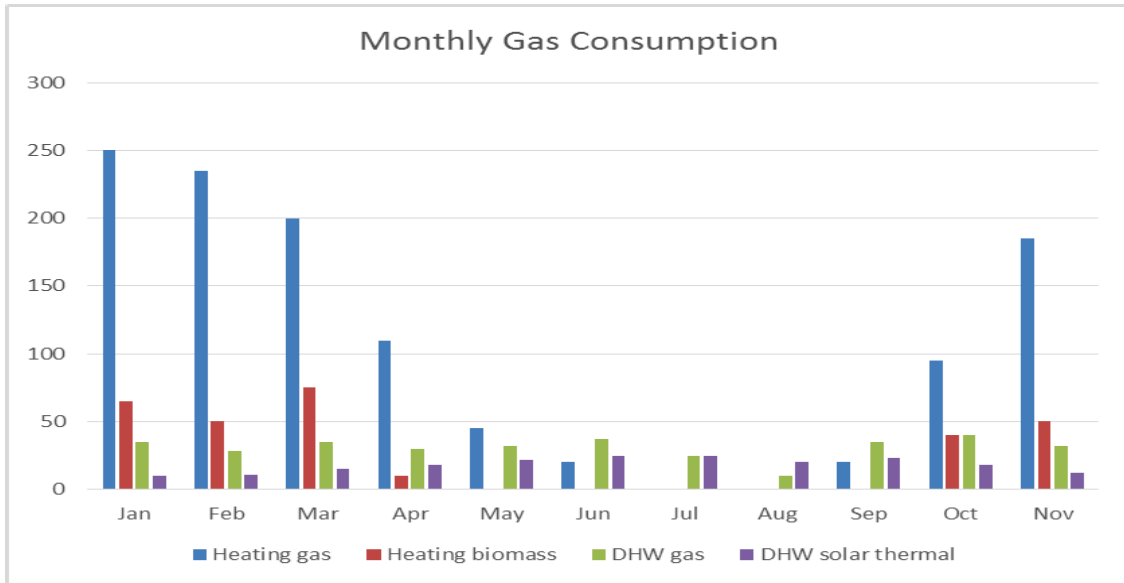


Figure 4 – Monthly Gas Consumption

2.2.3.3. The gas shall be presented in a similar manner as the electricity. If possible, the hot water shall be shown separately from the heating use. Also, if renewable heat is used alongside the gas, this shall also be presented. As with the electricity consumption a commentary shall be provided to explain the driving factors behind the patterns in consumption. [PM_10_20_82]

2.2.3.4. The water consumption shall also be shown with any contribution from rainwater harvesting or greywater recovery shown separately. [PM_10_20_82]

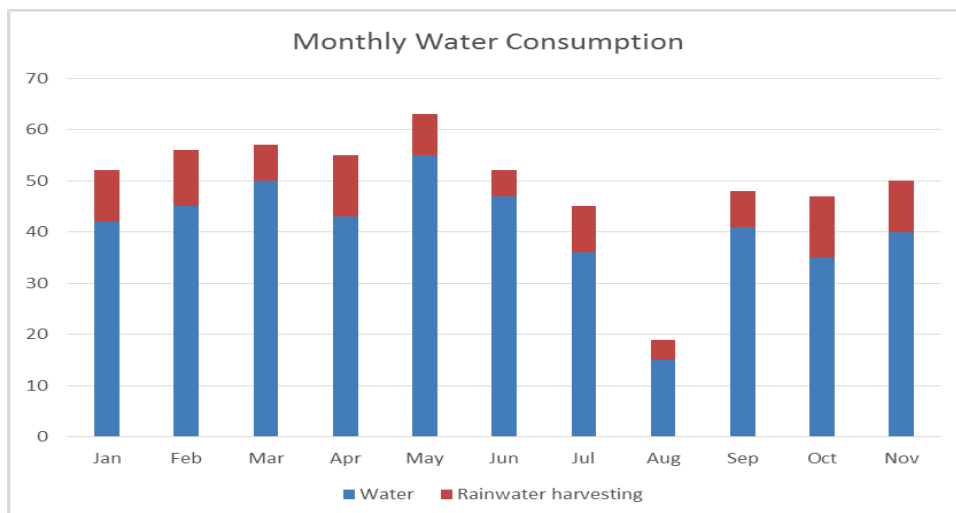


Figure 5 – Monthly Water Consumption

2.2.4. iSERV Analysis and reporting

2.2.4.1. The energy data that is uploaded to the iSERV or similar monitoring system shall be analysed to highlight areas of good and bad energy performance. The iSERV system will produce a report showing different areas of the building's energy performance measured against industry benchmarks. The main findings from this report shall be summarised here, paying particular attention to any areas that significantly exceed the benchmark consumption figures. [Ac_05_50_54]

2.2.5. Daily profiles

2.2.5.1. The energy consumptions for a summer day and a winter day shall be presented as shown in the following chart. [PM_10_20_82]

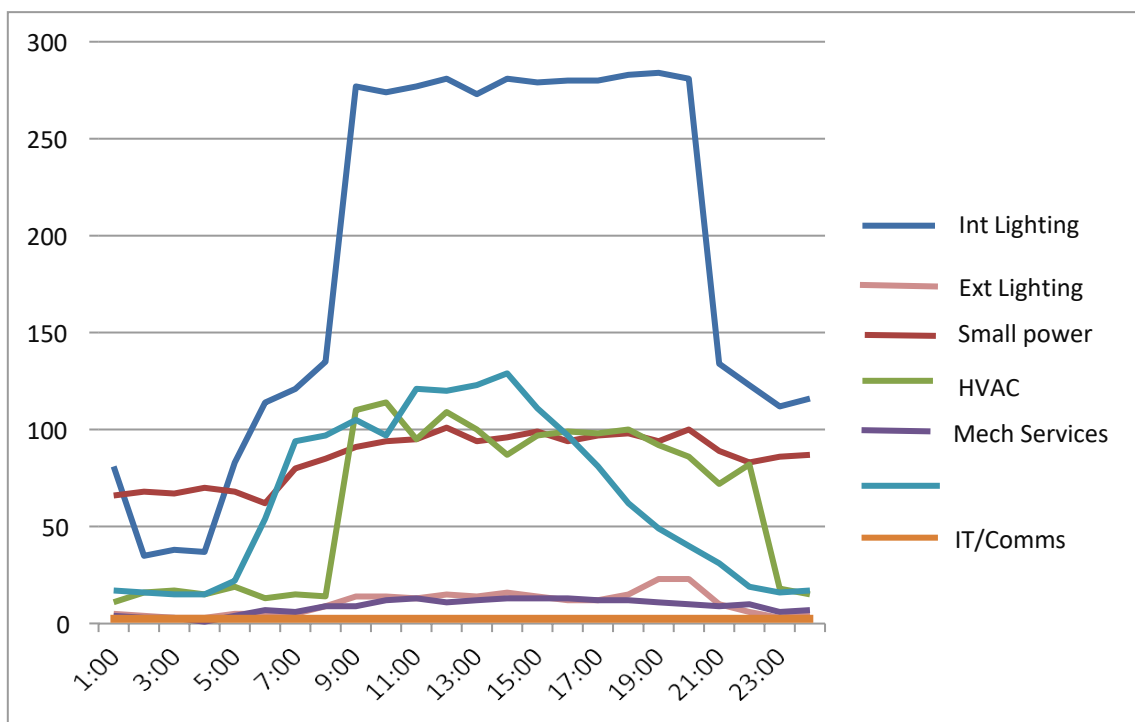


Figure 6 – Example of a daily energy profile for a school building

2.2.5.2. A commentary shall be provided which shows how the activities taking place within the School are mirrored by the energy consumption. For example, the energy usage of illumination is projected to peak on the basis of daytime and School Hours of service. This shall be reflected by annotation of a separate graph of the internal lighting metered data. [PM_10_20_82]

2.2.5.3. A table showing the comparison of the actual annual energy and water consumptions against the Contractors' design proposals and also the DfE energy benchmarks shall be included. [PM_10_20_82]

2.2.5.4. A commentary explaining what actions have been taken through items such as seasonal commissioning adjustments shall be provided. [PM_10_20_82]

2.2.5.5. Fine tuning and training to reduce energy consumptions and achieve design performance shall be included. [PM_10_20_82]

2.2.5.6. Where it is not clear what is driving any aspect of the energy consumption, this shall be clearly noted as an area for further investigation. [PM_10_20]

2.2.5.7. If the temperature and CO₂ levels are being monitored within the rooms then these too shall be recorded on separate daily profiles. If either the CO₂ or the temperature levels are found to be outside the design limits this shall be highlighted along with details of the potential causes. [PM_10_20_82]

2.2.5.8. Internal temperature is linked to the heating and ventilation systems and it can be useful to produce daily profiles showing the gas consumption and internal temperature in the winter, and the ventilation consumption and internal temperature in the summer. [PM_10]

3. Facilities staff interview results

3.1. The facilities staff interview is structured based on a multiple-choice format and as such the responses can be presented in the following table. [PM_10]

3.2. In addition to the table any specific details and issues raised during the interview shall be described in this section of the report. [PM_10_20_82]

Question Number	Question	Multiple Choice answer 1	Multiple Choice answer 2	Multiple Choice answer 3
1	Do you have any responsibility for the operation and/or maintenance of the Building's heating systems?	Yes	No	N/A

2	The training provided on the operation and/or maintenance of the heating system was	Good	Inadequate	Too complex
3	The heating controls are	Simple to use	Moderately simple to use	Complex to use
4	The level of feedback on the heating system provided by the control system is	Good	Inadequate	Too detailed
5	Issues with the heating systems are	Easy to identify	Slightly difficult to identify	Difficult to identify
6	Maintenance of the heating system is	Easy	Moderately difficult	Difficult
7	Do you have any responsibility for the operation and/or maintenance of the Building's cooling and ventilation systems?	Yes	No	N/A
8	The training provided on the operation and/or maintenance of the cooling and ventilation systems was	Good	Inadequate	Too complex
9	The cooling and ventilation controls are	Simple to use	Moderately simple to use	Complex to use
10	The level of feedback on the cooling and ventilation	Good	Inadequate	Too detailed

	systems provided by the control system is			
11	Issues with the cooling and ventilation systems are	Easy to identify	Slightly difficult to identify	Difficult to identify
12	Maintenance of the cooling and ventilation systems is	Easy	Moderately difficult	Difficult
13	Do you have any responsibility for the operation and/or maintenance of the Building's lighting?	Yes	No	N/A
14	The training provided on the operation and/or maintenance of the lighting/shading/blinds systems was	Good	Inadequate	Too complex
15	The lighting/shading/blind controls are	Simple to use	Moderately simple to use	Complex to use
16	Access to the light fittings for cleaning, replacement and maintenance is	Easy	Moderately difficult	Difficult
17	Using the metering system to compare energy consumption over the weekend with the weekday consumption is	Easy	Difficult	Not possible
18	Using the metering system to compare the energy	Easy	Difficult	Not possible

	consumption of this week with last week is			
19	The training provided for monitoring and reporting the school's water and energy use was	Good	Inadequate	Too complex
20	In terms of helping to understand, operate and manage the School, the Contractor's Aftercare Service was	Full and complete	Partly complete	Inadequate
21	Cleaning the school building is	Completely straight forward	Partly straight forward	Difficult

Table 8 – Example Format

4. Teaching staff survey results

4.1. General

4.1.1. A summary of the main findings in all areas shall be provided and any trends in poor building performance should be highlighted. [PM_10_20_82]

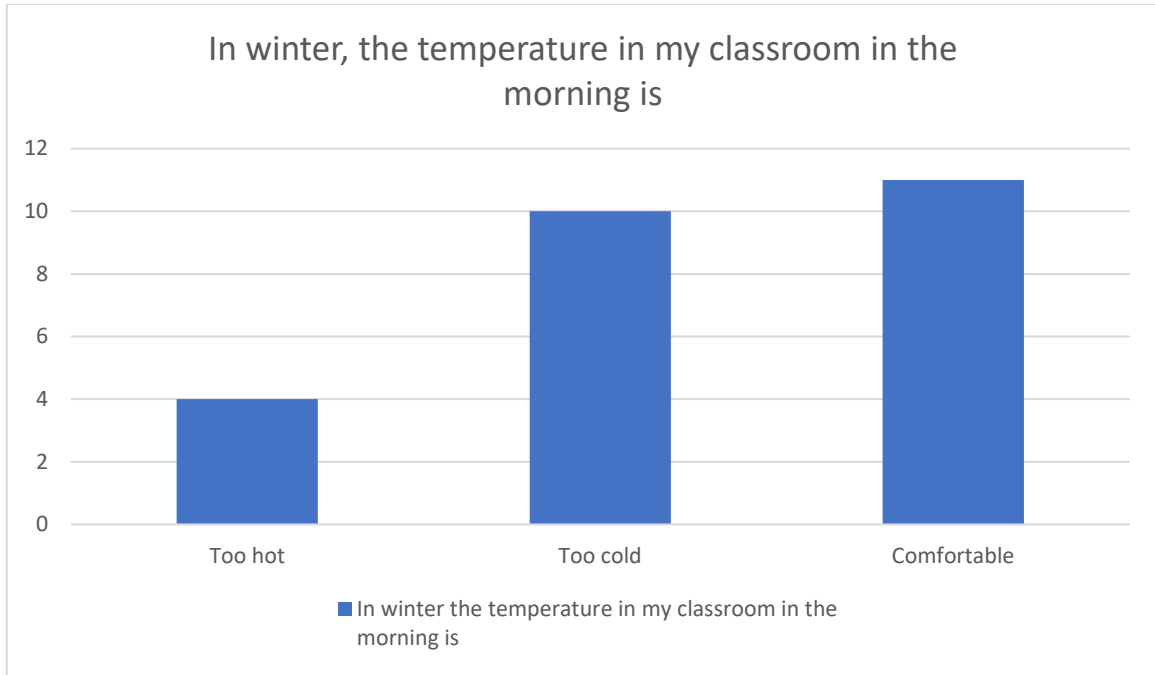
4.1.2. It is important when interpreting the staff survey results to look at the broad trends in the opinions rather than focusing on single points from individuals. [PM_10_20_82]

4.1.3. In addition to the summary, the responses to the individual questions shall be presented in a graphical format. [PM_10_20_82]

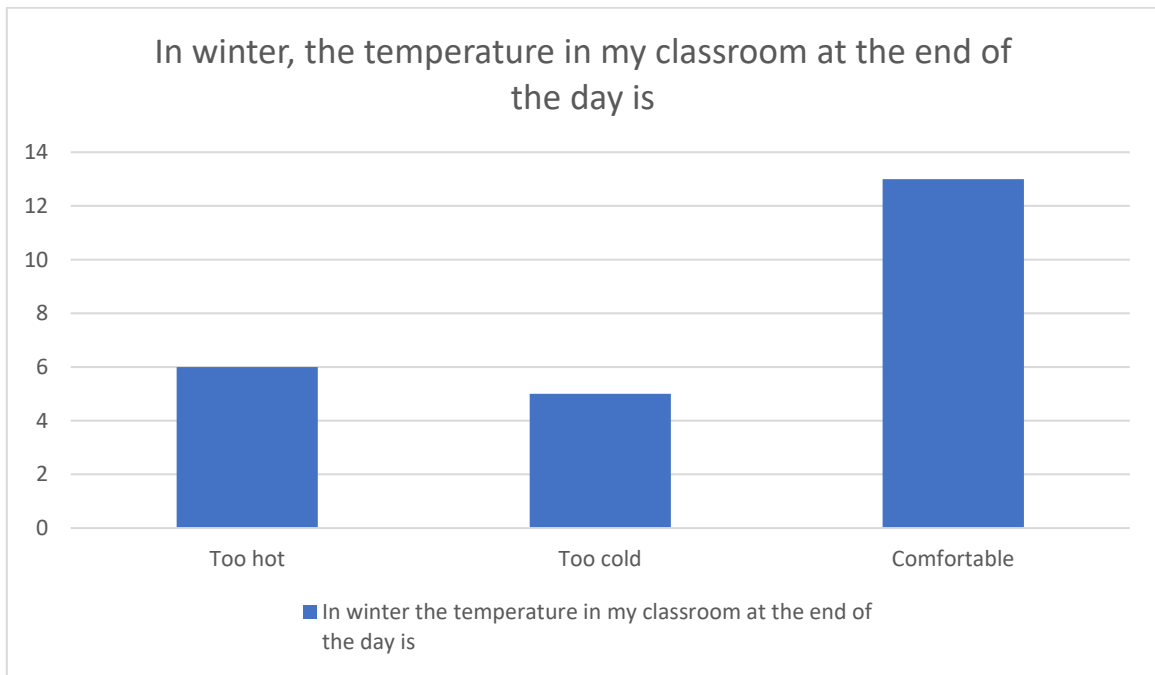
4.1.4. A spreadsheet answer template is available to assist with this process. [PM_10]

4.1.5. Although the questions are multiple choice there are spaces on the answer sheet for the respondents to provide further details if required. [PM_10]

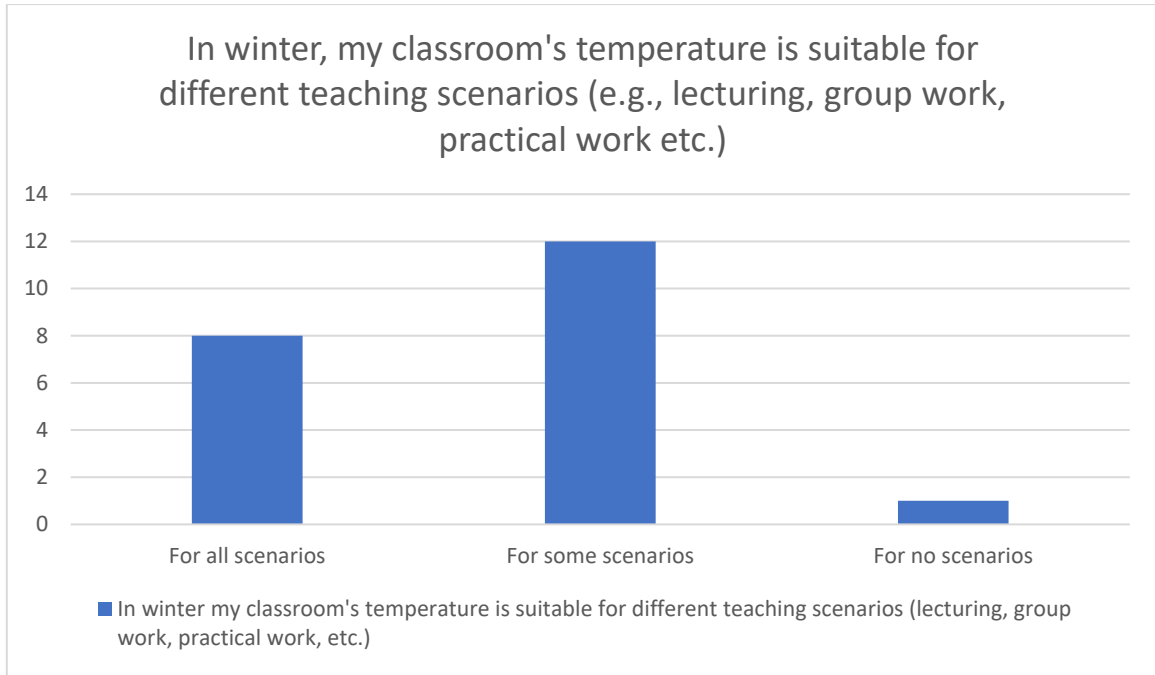
4.1.6. These additional responses shall be reported below the graphs. As shown in the following examples. [PM_10_20_82]



Question 1 - Winter morning temperature in the classroom



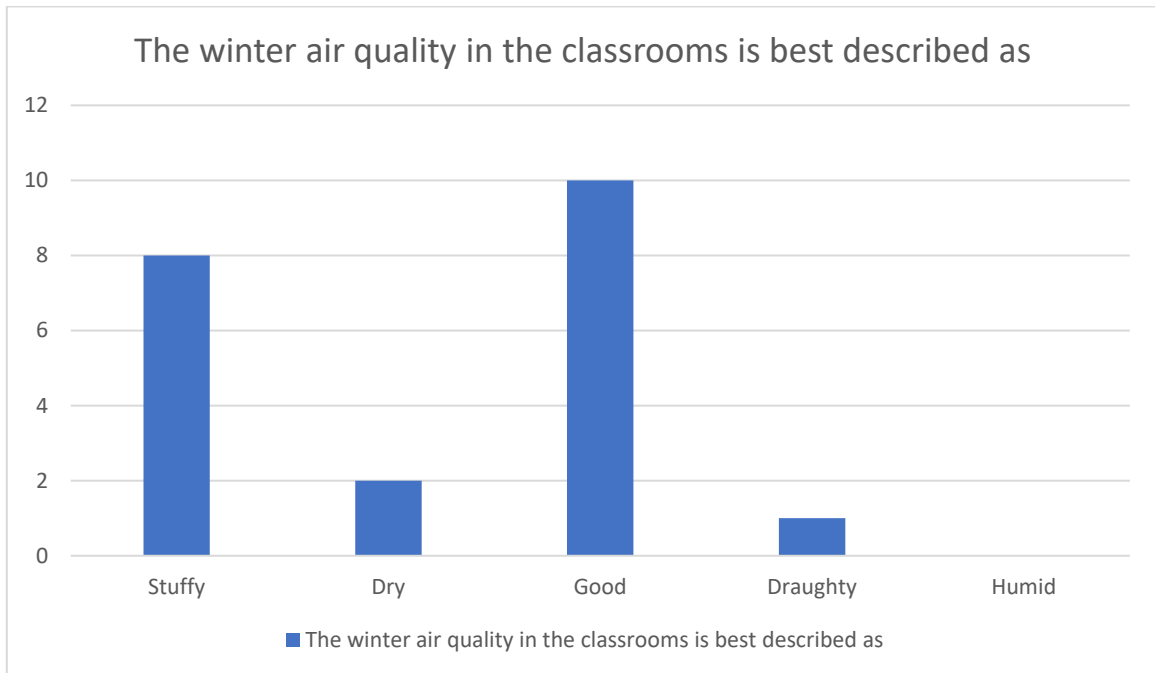
Question 2 - Winter end of the day temperature in the classroom



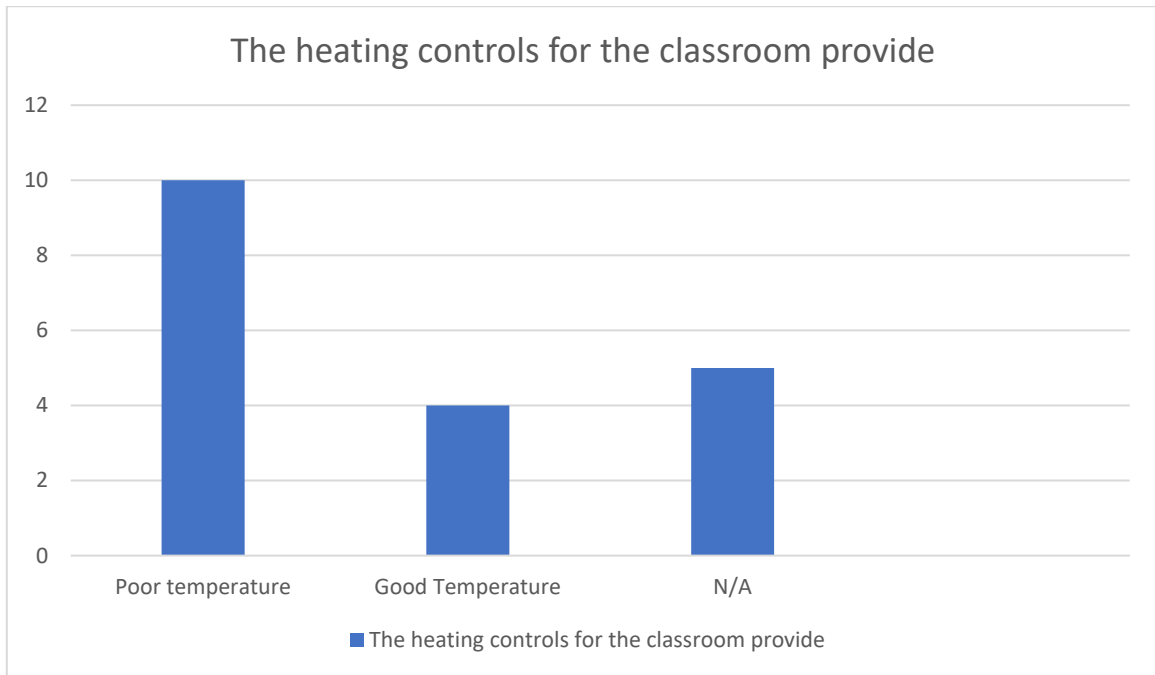
Question 3 - Winter classroom temperature suitable for different teaching scenarios

“Towards the end of the day students are drained and lack energy and motivation.”

“The room is hot and stuffy.”



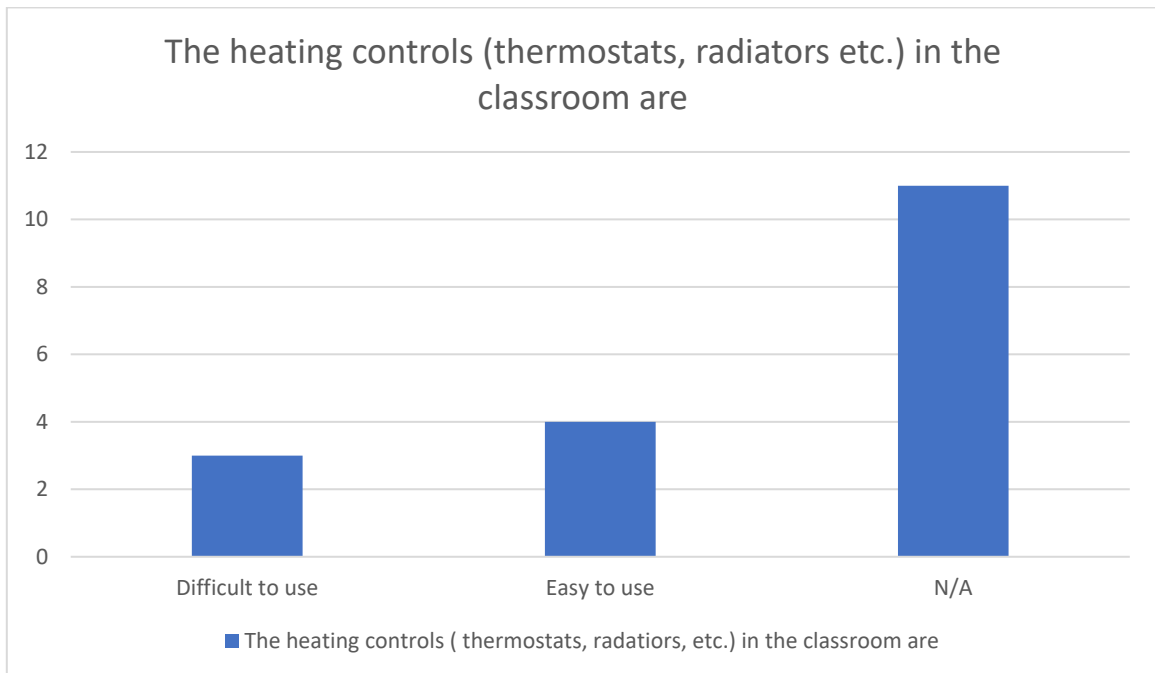
Question 4 - Winter air quality in the classroom



Question 5 - Heating controls for the classroom

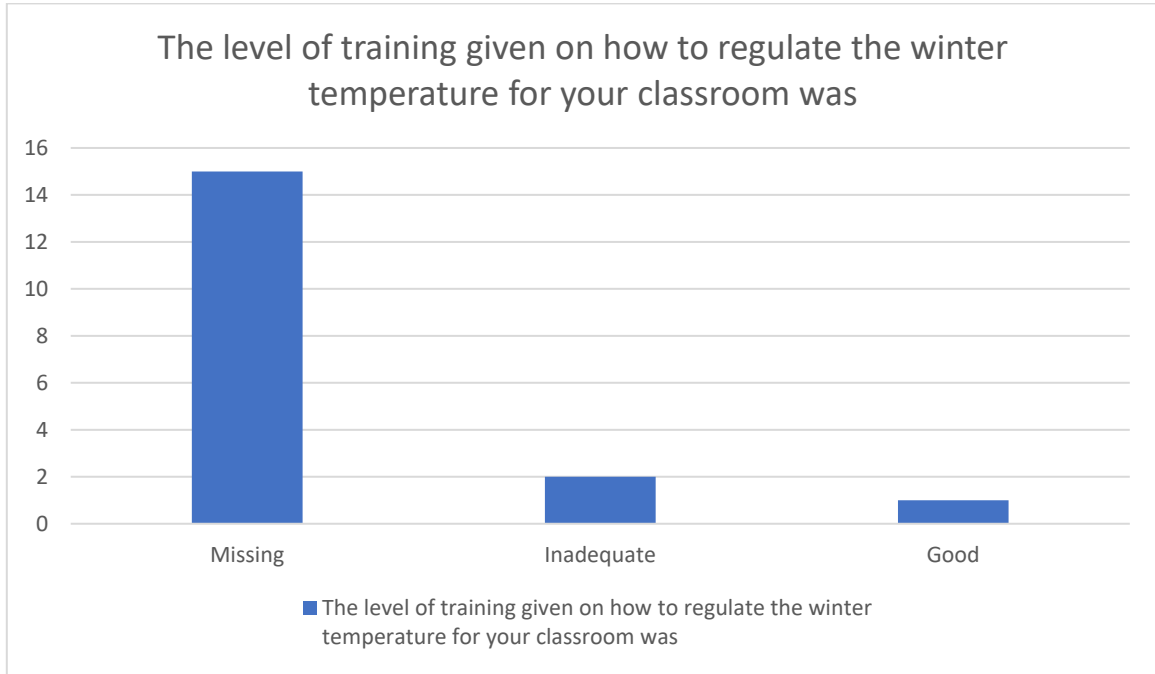
“The temperature stays the same even if the controls are adjusted.”

“The thermostat has no effect.”

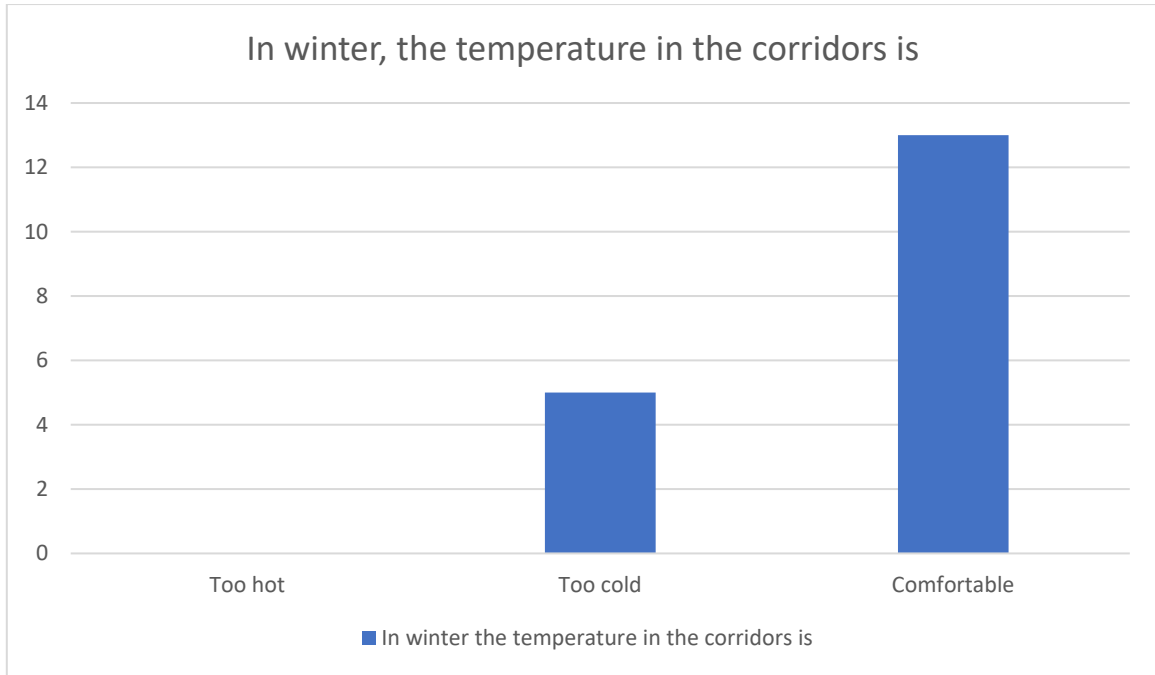


Question 6 - Heating controls in the classroom

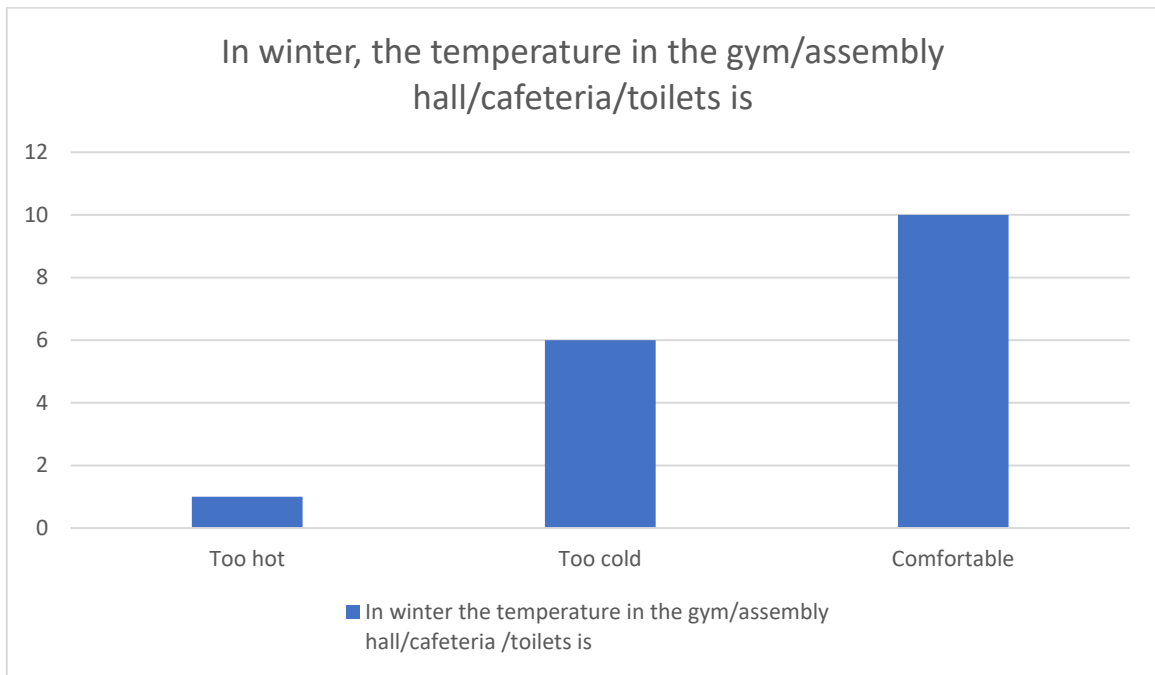
“The controls make no difference to the temperature.”



Question 7 - Level of training given on how to regulate the winter temperature in the classroom



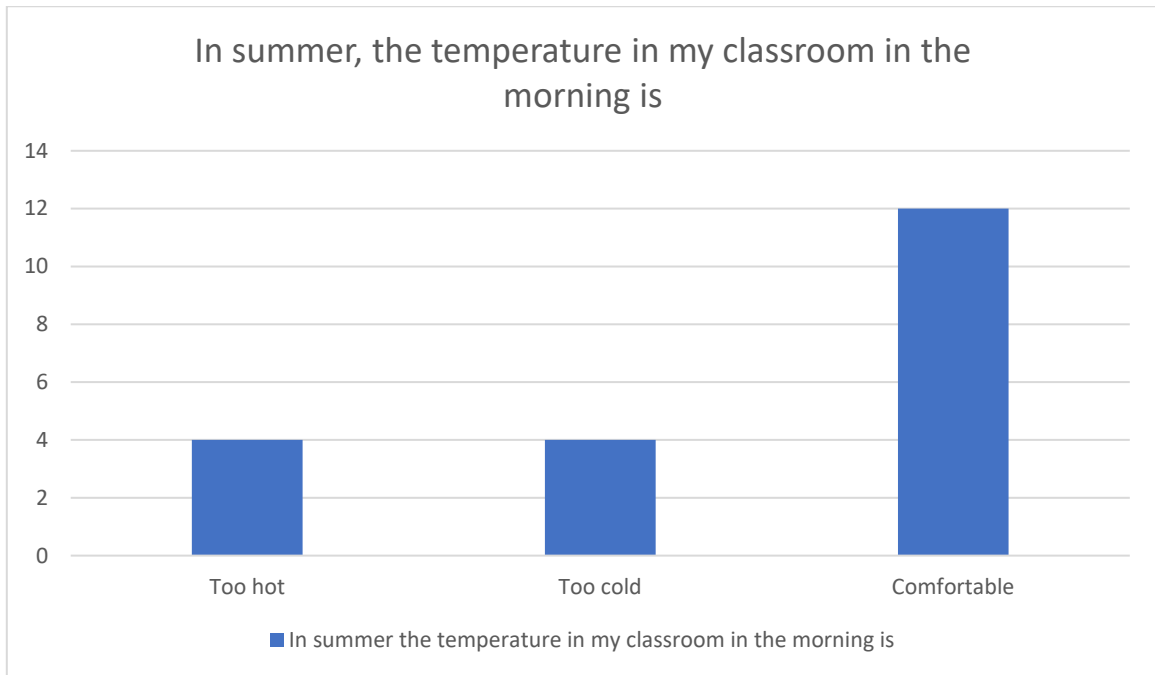
Question 8 - Winter temperature in the corridors



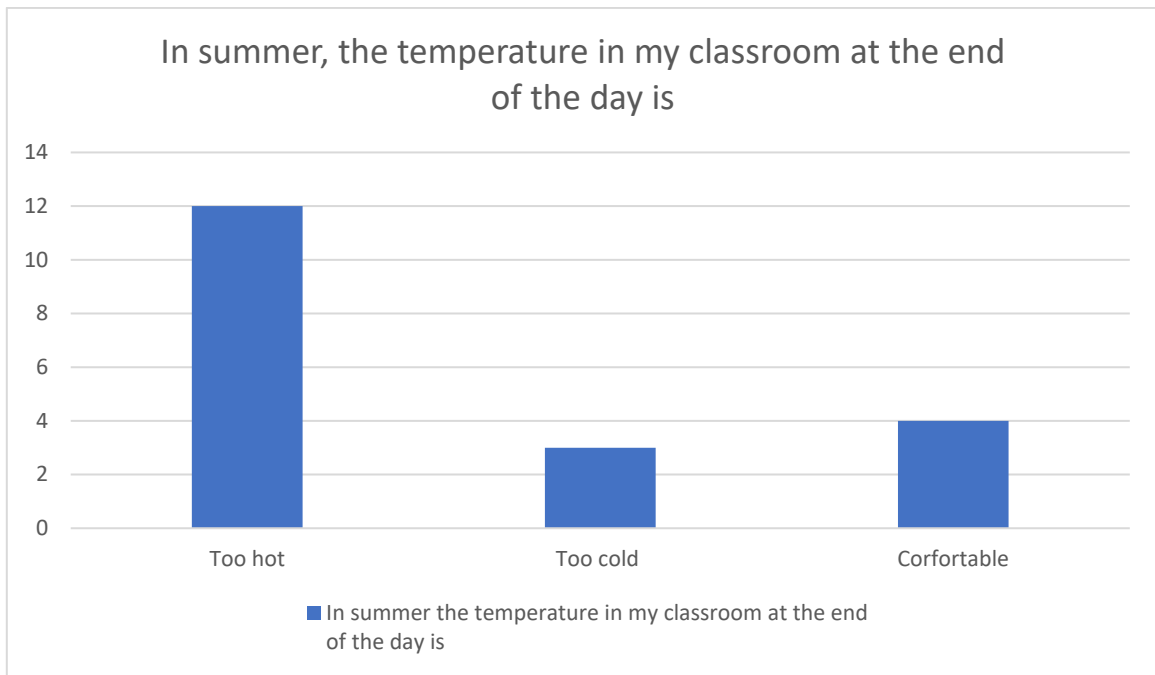
Question 9 - Winter temperature in the gym/assembly hall/cafe/tertia/toilets

“Always very warm.”

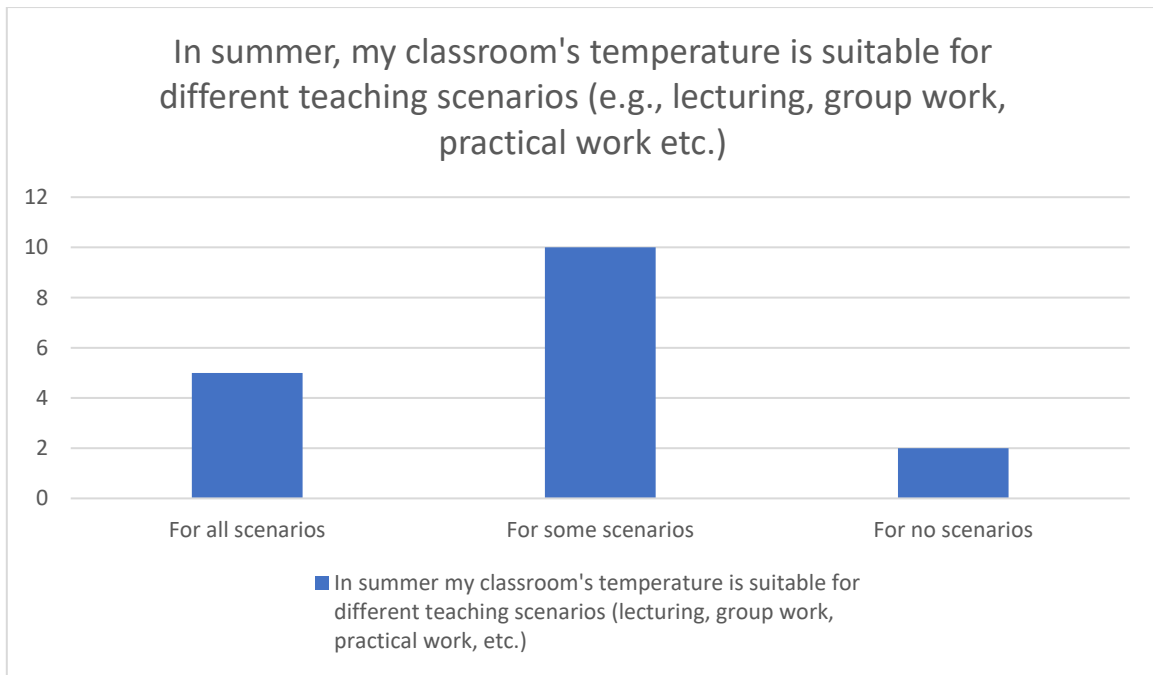
“The sports hall is very warm.”



Question 10 - Summer morning temperature in the classroom



Question 11 - Summer end of the day temperature in the classroom



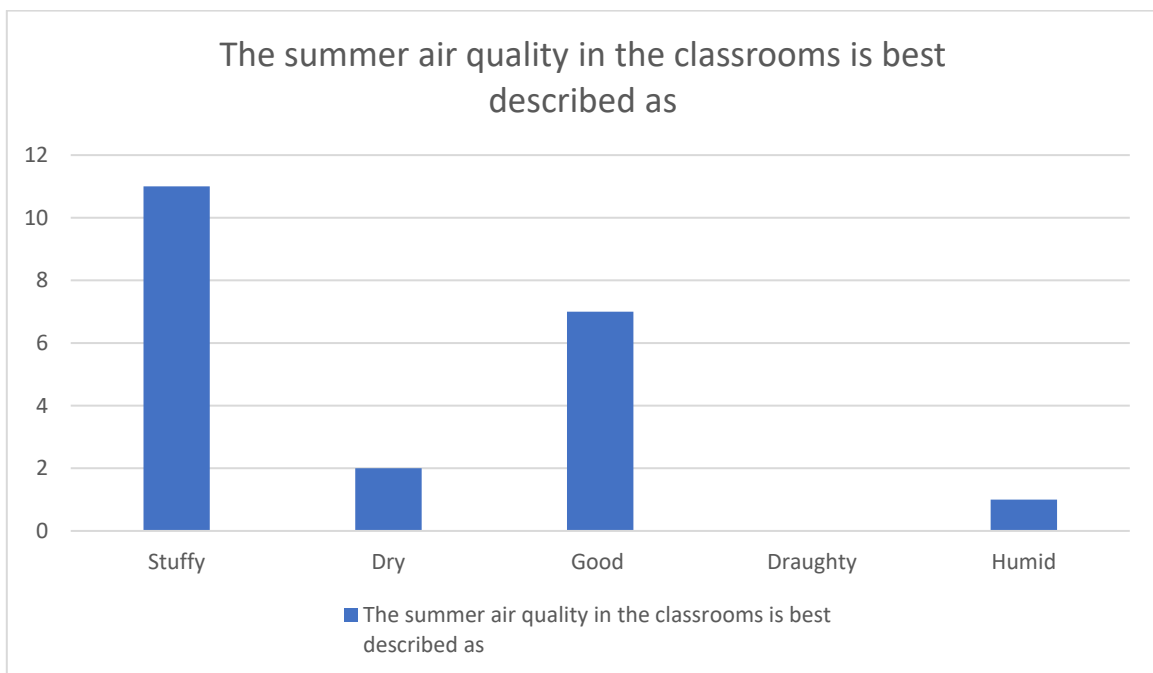
Question 12 - Summer classroom temperature suitable for different teaching scenarios

"We carry out daily duties, however temperature and environment make these difficult and exhausting."

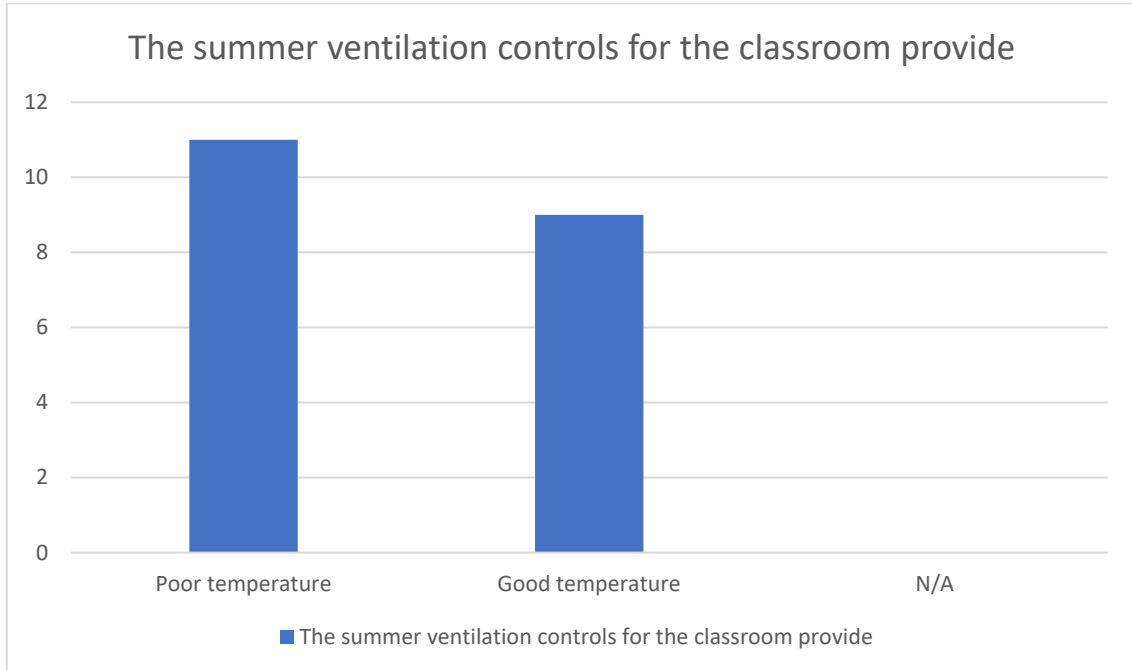
"Leave the unit feeling tired and unwell during the summer months."

"No fresh air circulation."

"Room is very warm and stuffy."

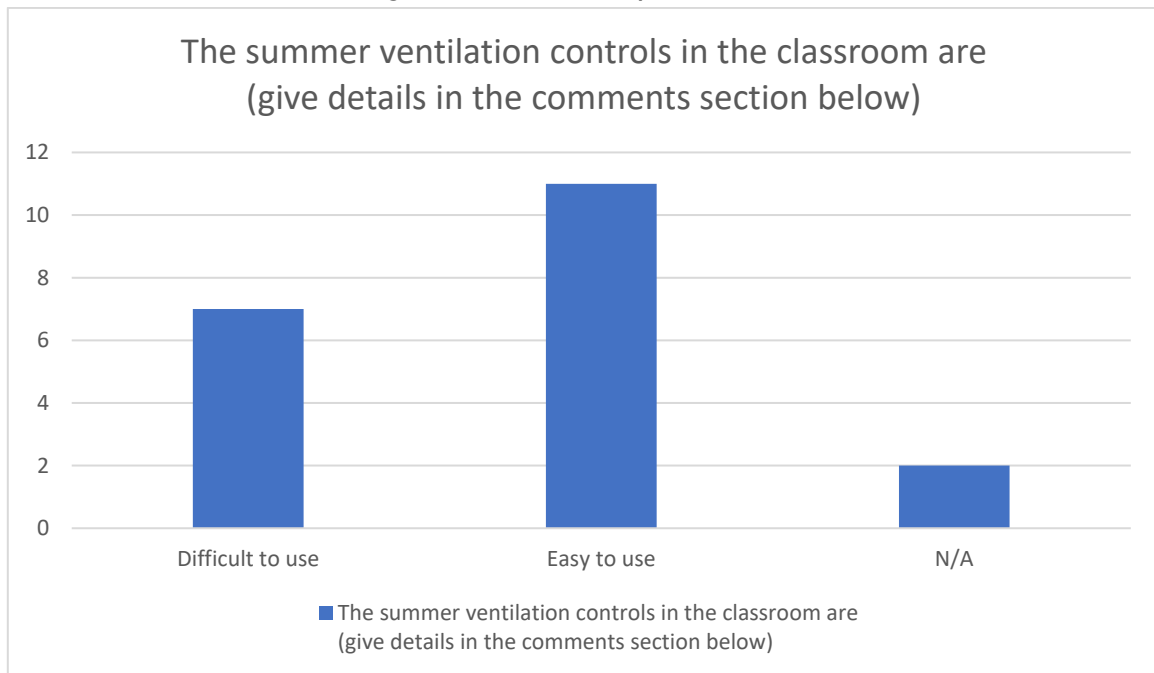


Question 13 - Summer classroom air quality



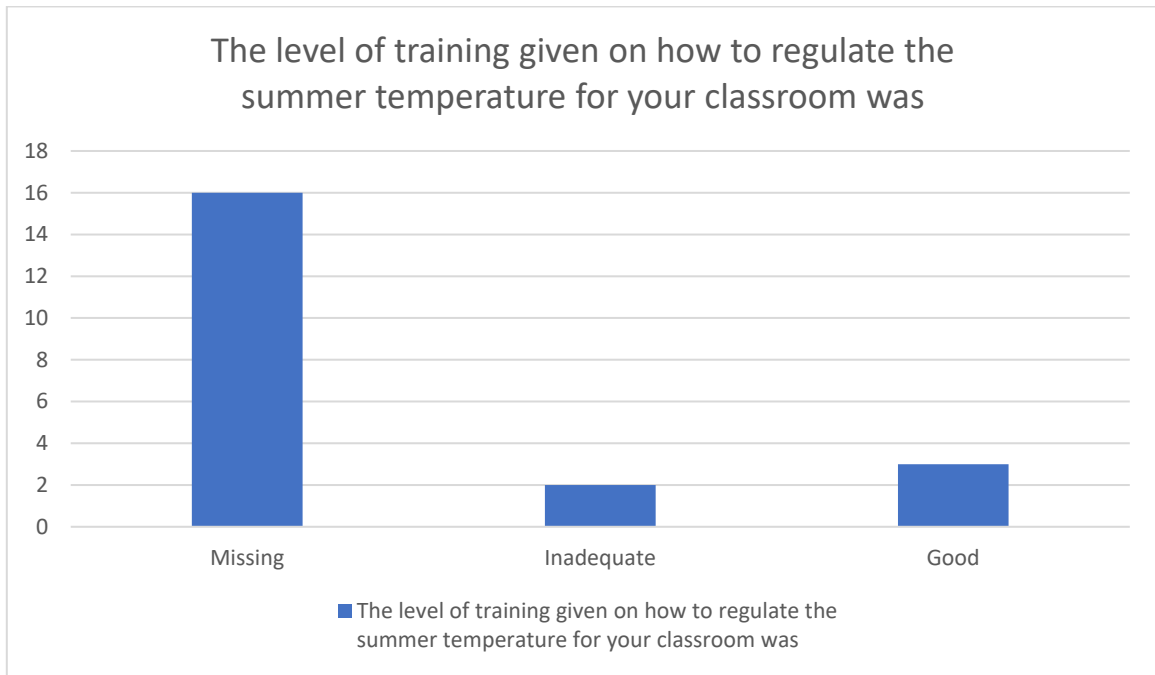
Question 14 - Summer classroom ventilation controls provide

“The air conditioning is set as low as possible.”

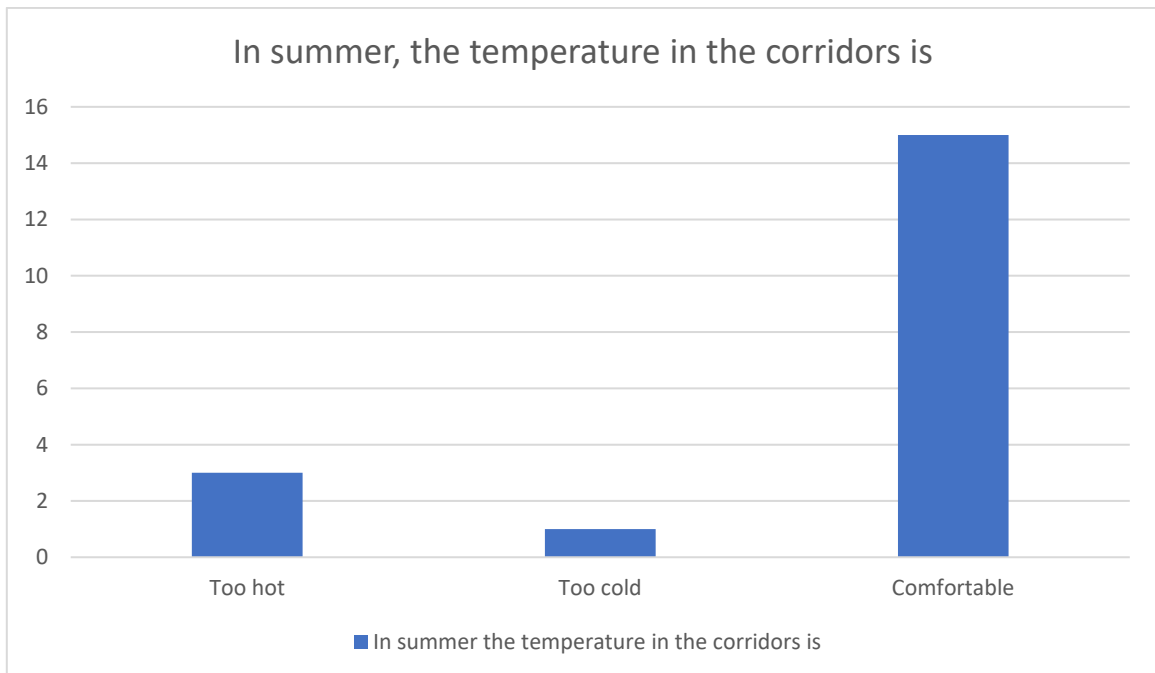


Question 15 - Summer classroom ventilation controls are

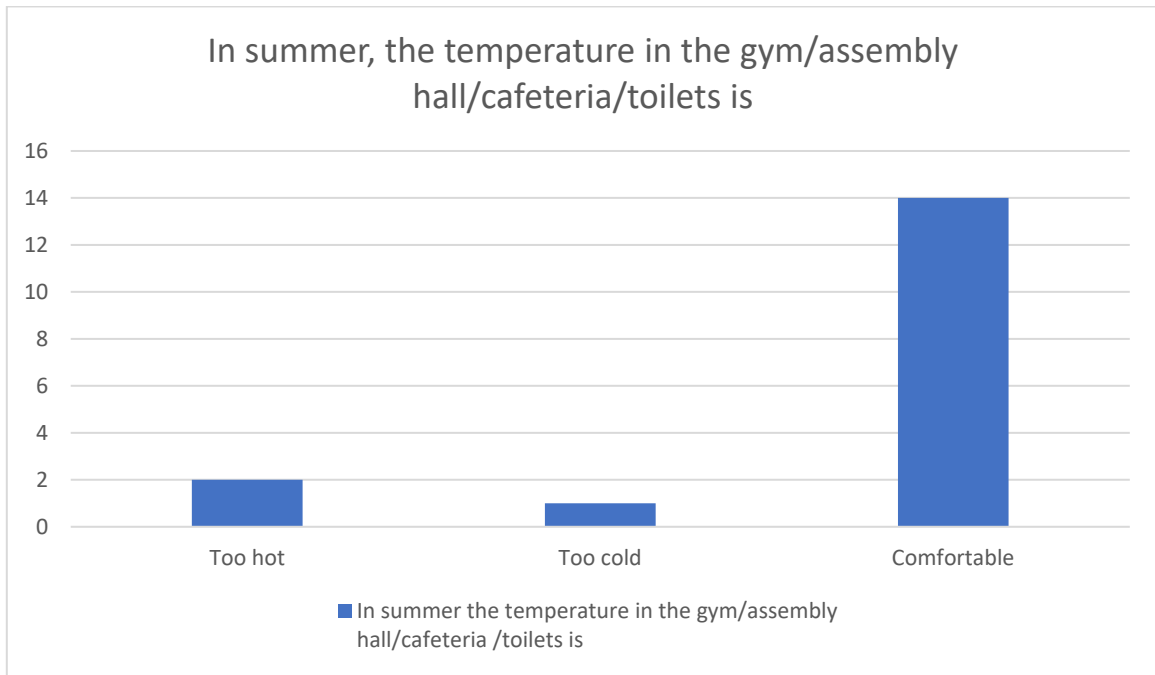
“The controls make no difference.”



Question 16 - Level of training given on how to regulate the summer temperature in the classroom

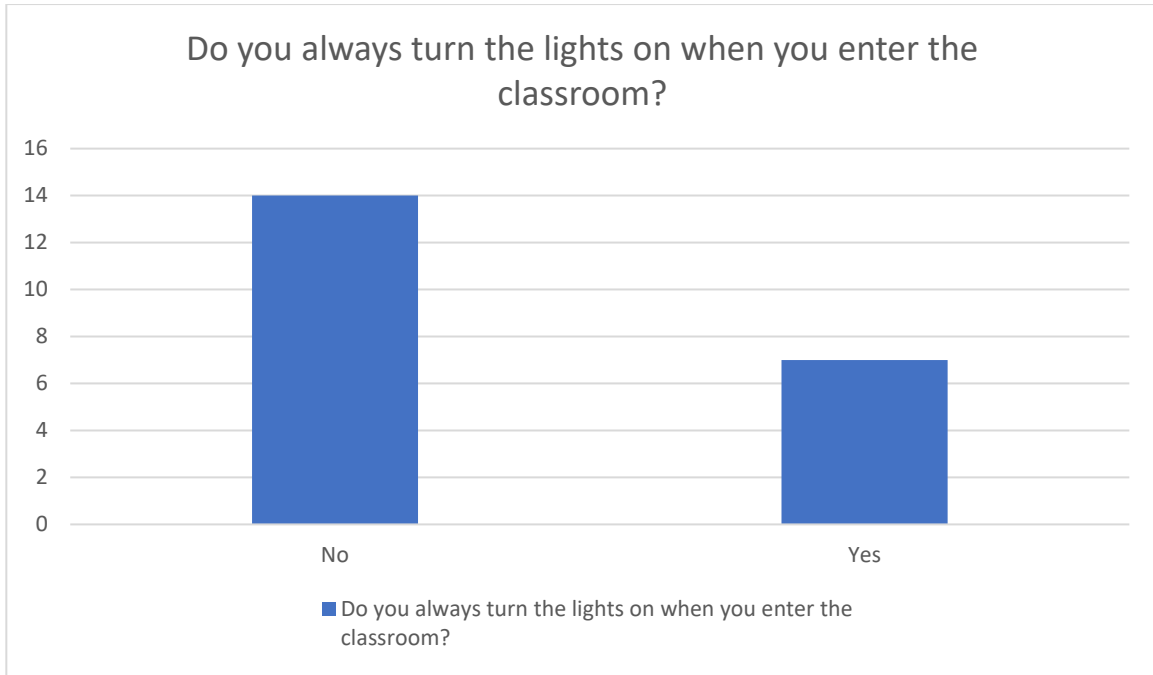


Question 17 - Summer temperature in the corridors

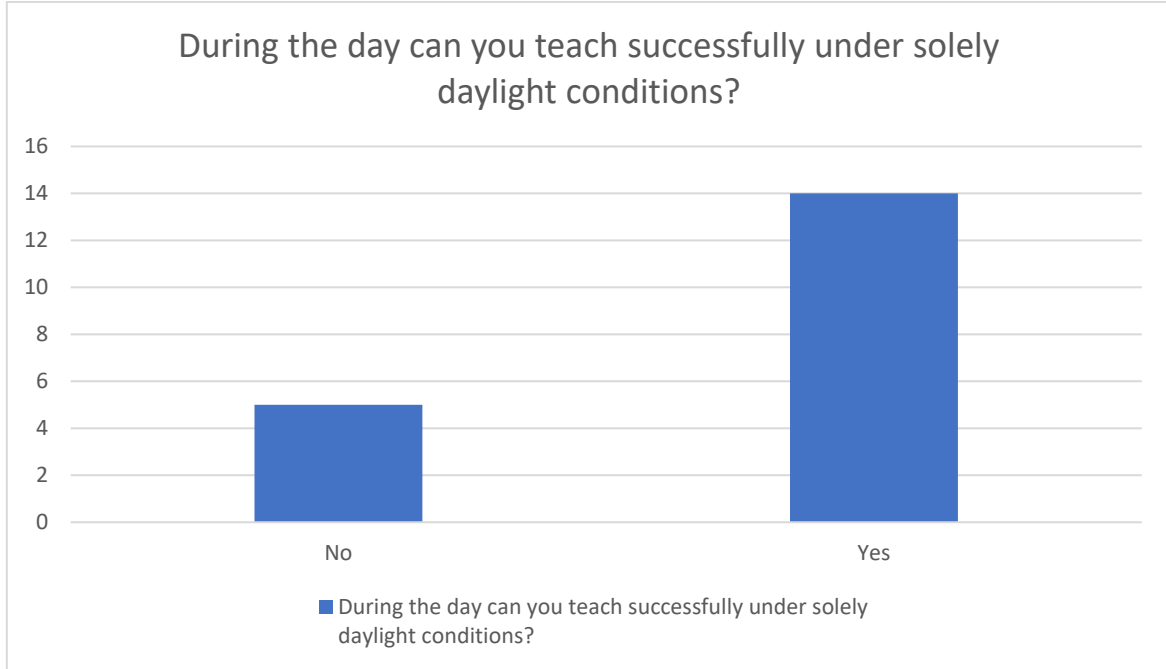


Question 18 - Summer temperature in the gym/assembly/hall/cafe/teria/toilets

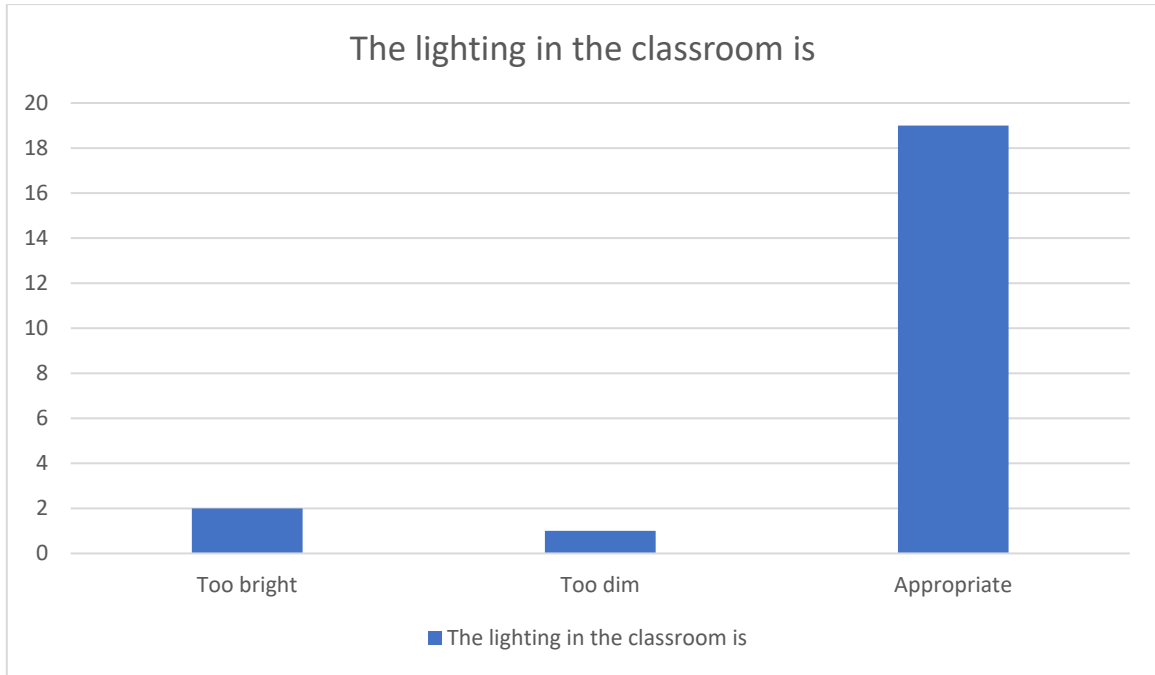
“The temperature varies from 25.4°C to 28.1°C in the summer.”



Question 19 - Turning on lights when entering the classroom

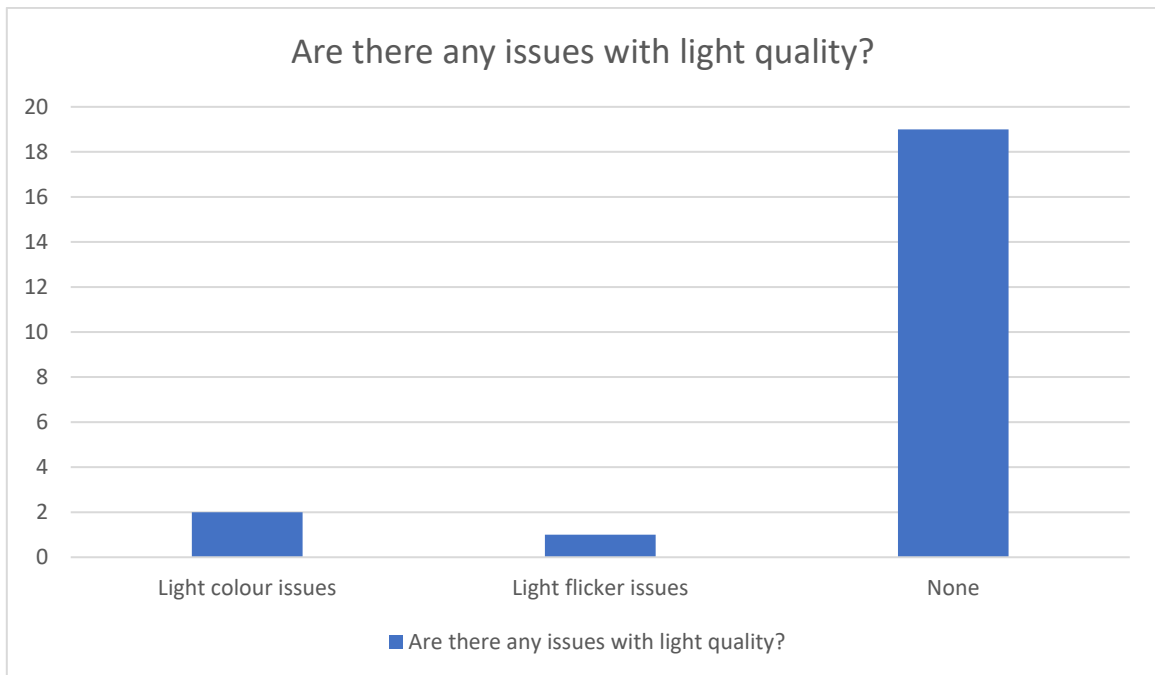


Question 20 - During the day teaching successfully under daylight conditions

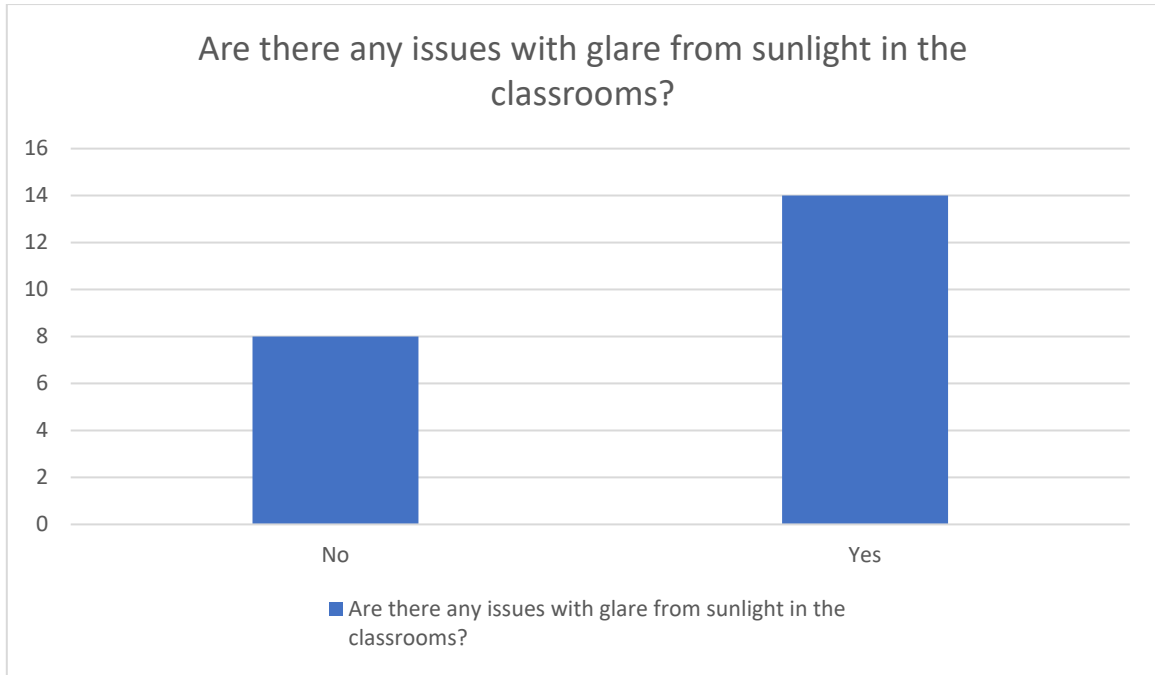


Question 21 - Classroom lighting

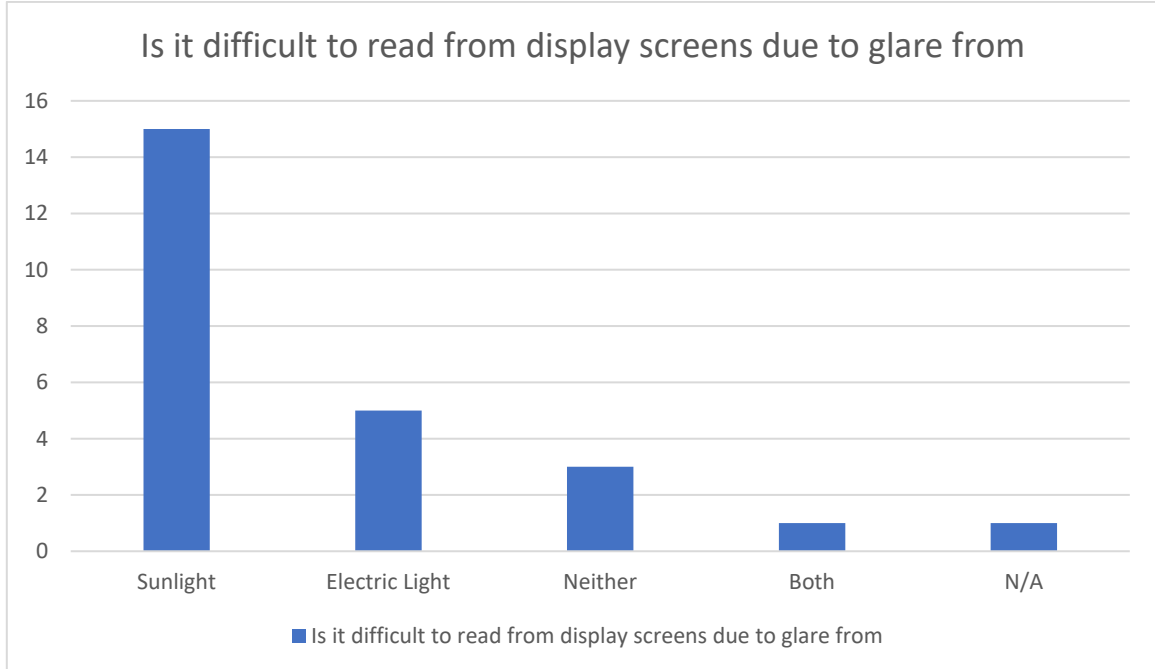
"The lights are ill placed."



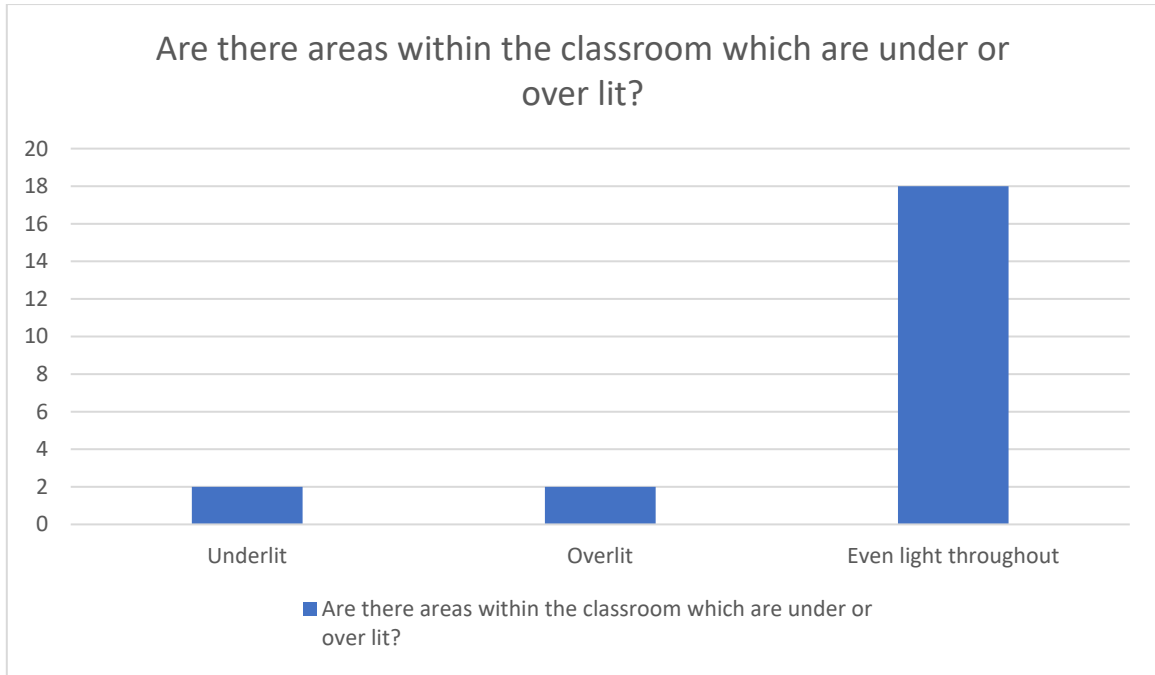
Question 22 - Light quality issues



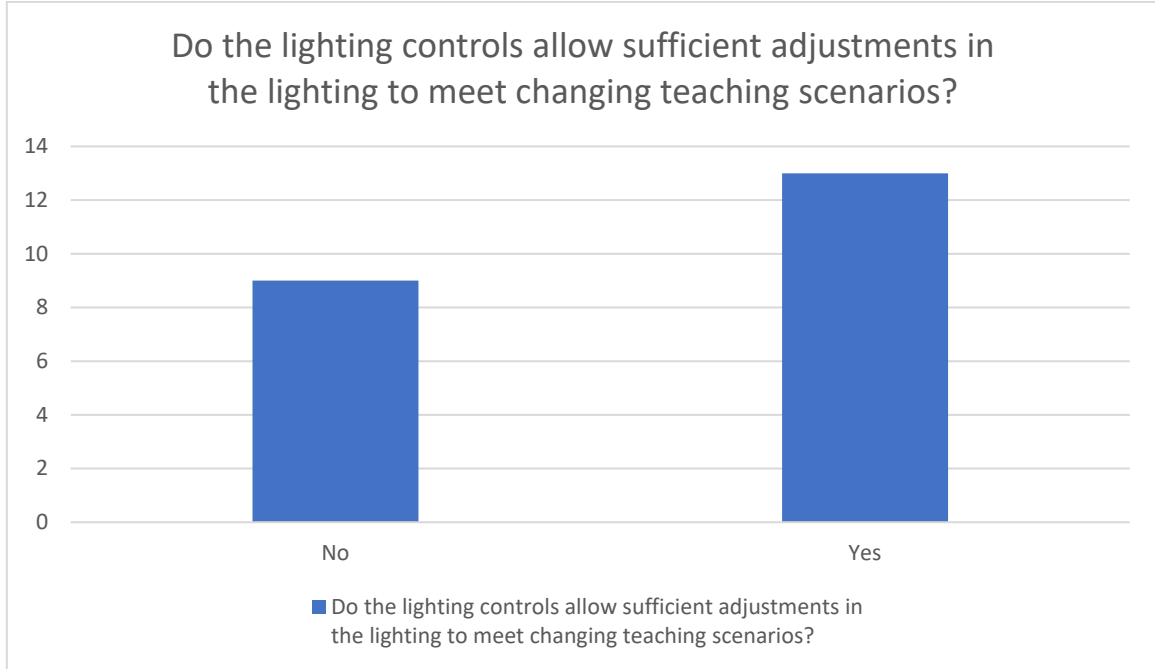
Question 23 - Glare issues from sunlight in the classroom



Question 24 - Difficulty when reading from display screens due to glare

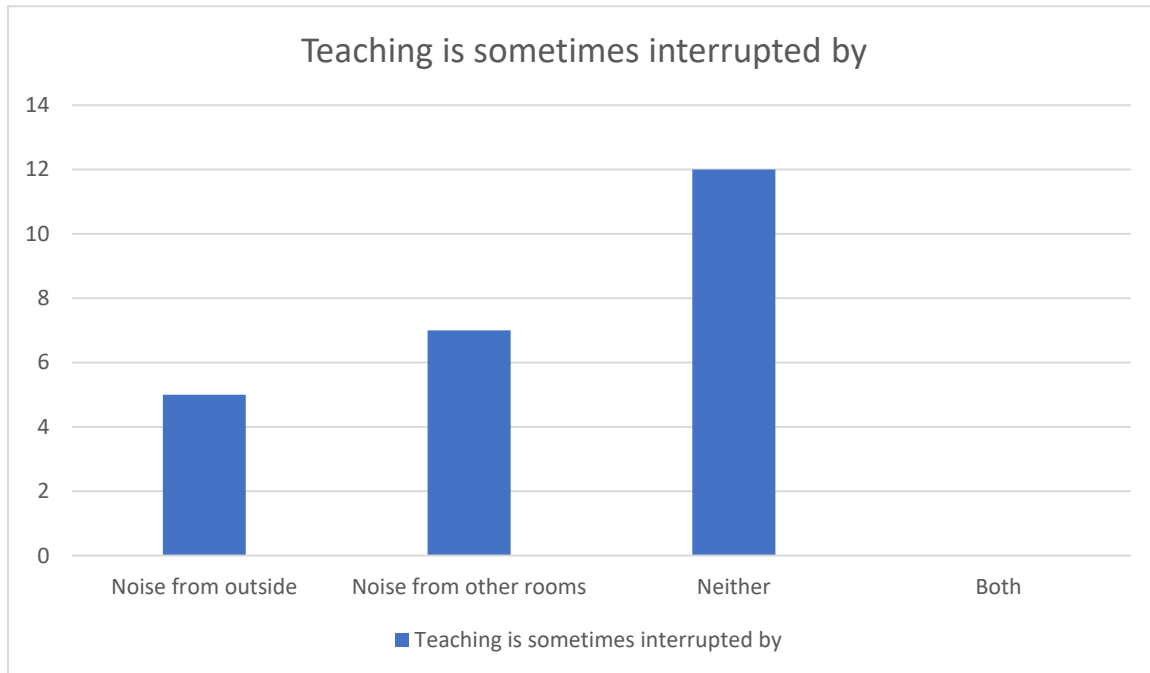


Question 25 - Areas within the classroom that are under or over lit



Question 26 - Lighting controls allowing sufficient adjustments in the lighting to meet changing teaching scenarios

“There are light and dark areas within the room.”



Question 27 – Teaching interruptions

General comments:

“Gets too hot in the office and doors have to be propped open.”

“The office gets hot and stuffy. When the sun shines on the side of the building it gets very hot.”

“Door is always open to get air circulating. Staff room is noisy.”

“Fire door needs to be open to cool the office.”

“Nothing ever changes despite contractors trying.”

“Room is always warm and stuffy. We only have half the lights on and need to keep the student access hatch open all day which is noisy.”

5. Conclusion

5.1. The conclusion shall bring together all the information from the energy data analysis alongside the responses from the facilities staff interviews and staff questionnaire. [PM_10_20_82]

5.2. It is important to look at all the information together to draw any links between the monitored energy consumption data and the experiences of the building users. [PM_10_20_82]

5.3. Any notable trends or patterns in the findings shall be highlighted. [PM_10_20_82]

5.4. An action plan of issues to resolve any areas for further investigation shall be put together along with a recommendation for the priority they shall be given. [PM_60_30_05]

5.5. Once completed, the report shall be issued to the School for them to consider any further action. [PM_10_20_82]

Appendix E In-use energy monitoring using iSERV reporting methodology

1. Overview

1.1. A well designed and commissioned and fully functioning metering and monitoring system as described in the Generic Design Brief (GDB) is an Employer's Requirement Deliverable. [PM_10_20_82]

1.2. It is fundamental to the monitoring and targeting process that is, in turn, an essential part of energy management. [PM_80_10_60]

1.3. The Contractor is required to establish feedback mechanisms which enable monitoring of the energy status and operation of the School. [PM_80_10_60]

1.4. These mechanisms shall be used to inform building managers whether the energy consumption is greater than expected. [PM_80_10_60]

1.5. Metering and monitoring are used to obtain robust, error free insights into the operation and energy consumption of a system. [Ac_05_50_54]

1.6. Metering, monitoring and reporting in a clear readily understandable format is a requirement to improve operational energy, water efficiency and building performance. [Ac_05_50_54]

1.7. Metering enables the building operator to measure and verify the energy and water consumption of the Building and identify areas where irregular energy consumption occurs. [Ac_05_50_54]

1.8. The information collated from the energy meters shall allow continuous monitoring, benchmarking and post occupancy Building Performance Evaluation against operational targets. [PM_80_10_60]

1.9. The metering and monitoring strategy shall reflect the size, complexity and facilities management approach of the School. [Ac_05_50_54]

1.10. The more complex the services solution, the more sub-metering shall be required. [Ac_05_50_54]

1.11. End use data should always be able to be presented as simply as possible to aid understanding. [PM_10_20_82]

1.12. The Contractor shall ensure that the systems are metered according to the requirements detailed in the GDB and Technical Annex 2I. [PM_10_20_90]

2. Continuous Monitoring

2.1. Continuous monitoring of the energy end uses shall be used to compare consumption to benchmark end use loads. [Ac_05_50_54]

2.2. The data shall allow the School's facility managers to identify and remedy problems such as inadequate system control or incorrect default settings. [PM_80_10_60]

2.3. Contractors shall use the iSERV methodology to automatically monitor and report on the energy and water use of the School or Buildings in the case of a project involving part of the School. This requirement applies for any Building of over 500m². The reporting of consumption and performance in use of the Buildings, shall be carried out using the K2n system or similar system approved by the Employer. [Ac_05_50_54]

2.4. iSERV enables continuous improvement in school's energy and water performance based on potential savings identified by the collection and analysis of real time energy and water end use data. It monitors plant performance related to different activity areas and compares performance to existing benchmark data. It can be used to identify Energy Conservation Opportunities (ECOs). [Ac_05_50_54]

2.5. The Contractor shall complete the K2n building assets description spreadsheet, ensuring all component, system, sensor and meter names relate to physical items or spaces where possible. [PM_10_20_82]

2.6. The Contractor shall be required to provide the initial first year 15-month subscription and set up this service for the School or Buildings and help the School to use the system to benchmark the performance of the School or Buildings during the 12 months post-handover. [PM_80_10_60]

2.7. The Contractor shall use the system to prove that all connected meters are calibrated correctly and will remedy any faults in the metering system during the defects liability period. [PM_10_20_82]

2.8. Further information can be found at www.k2nenergy.com. [PM_10]

3. Requirement

3.1. Contractors shall supply 15-minute interval continuous monitoring and benchmarking data to the K2n National Database (or similar system approved by the Employer) on at least a monthly basis, and preferably on a daily basis, to enable automated reporting against DfE targets on a monthly basis and quarterly feedback from the Contractor to the School during the 12-month defects liability period. [Ac_05_50_54]

3.2. DfE and K2n have set up and developed K2n National Database, based on the iSERV methodology, to establish realistic benchmarks and feedback in use for school buildings and have developed reporting formats for monthly reports to schools and Contractors. [PM_10]

3.3. These reports shall help schools to manage their energy consumption and identify avoidable waste. [PM_80_10_60]

4. Monthly reports of achieved performance

4.1. The K2n monthly reports should be used to provide the feedback interface for the School users by means of the agreed monthly reporting templates. [PM_80_10_60]

4.2. Providing these monthly reports to the Schools shall enable them to provide appropriate control over those energy consumers which they influence, helping the overall School energy targets to be achieved. [PM_80_10_60]

4.3. Alternatively, with the Employers' approval, Contractors can choose to use other energy management reporting software to produce similar feedback reports for the School provided the report formats have been approved by the DfE. [PM_80_10_60]

4.4. Monthly reports can be set to report progress against any designated end of year month. [PM_10]

4.5. For the first year this should be based on sector average consumption profiles, for year two onwards this shall be profiled against the previous twelve months for the School. This enables tracking of consumption over the year, prediction of progress against contractual targets to be assessed as part of BPE and allows early corrective action to be taken if needed. See Section 8 of GDB. [PM_10_20_90]

5. Data required

5.1. To participate in the wider community of Building Owners/Operators/Energy Managers providing data to K2n and the DfE, which enables up-to-date national benchmarks to be produced and maintained for DfE funded schools and their systems, the DfE requires the Contractor to comply with the K2n data reporting standards. To enable this to happen the data from schools shall be submitted in the agreed format. If the Contractor chooses to use a similar system to K2n to record and analyse data and to produce reports, the system still needs to upload monthly 15-minute data as required by the Project Agreement to the K2n National Database for DfE benchmarking purposes. The data format shall need to be compatible with the K2n National Database. Approval will depend on demonstration of regular successful transfer of the data. [FI_30]

5.2. This requires the Contractor to fully describe each School with the data requested in the fields in the K2n building assets spreadsheet. The Contractor shall request the latest DfE spreadsheet from K2n. The latest version can be obtained on request from info@k2nenergy.com. A completed spreadsheet for an example school shall also be provided. [FI_30]

5.3. The operational data required for the meters and sensors described in the K2n building assets spreadsheet can usually be exported via a BEMS system, or directly from meters and sensors with the appropriate data collection and transmission facilities. [FI_30]

5.4. Alternatively, manual transmission of the data to a dedicated email address can also be used to transmit the data to K2n. This shall need to be sent by midnight on the 1st of each month, including all data for the previous month, to enable inclusion in the automated reports which will be sent to the Contractor and the Employer (and School if required). [FI_30]

5.5. The minimum level of sensor data required is zone space temperature sensor data for each heating zone and data from an outside air temperature sensor. This allows energy performance and building systems performance to be evaluated. The Contractor may choose to include additional sensor data. Example, room temperature and CO₂ sensor data for each room, in order that further insights into the effectiveness of the Building Services HVAC systems can be provided to the School and Contractor. The K2n National Database is capable of assessing energy use per space if appropriate sensors are in place. [FI_30]

5.6. Contractors can use this data to aid seasonal commissioning adjustments during the 12-month defects liability period. Correlating the internal conditions with energy consumption enables the identification of avoidable energy use, building performance issues and sensors or meters that are likely to be out of calibration. This is a powerful means of remote system diagnosis. [FI_30]



Department
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