

Introduction



The presented study explored how electric lighting in school classrooms affects pupils' learning and performance, and how that can inform the way schools are designed, renovated, and evaluated. Considering that many schools are currently upgrading their lighting systems, and introduce digital tools and flexible learning environments, there is an increasing need to ensure that lighting supports pupils' and teachers' needs.

Identifying the research gap

A key gap identified in this study is that school lighting is usually designed for adults and evaluated from an adult point of view. Children of different ages experience light differently due to their height, field of view, and developing visual and nervous systems. As a result, vertical illumination, spatial light distribution, and reflections are often overlooked from children's vantage points.

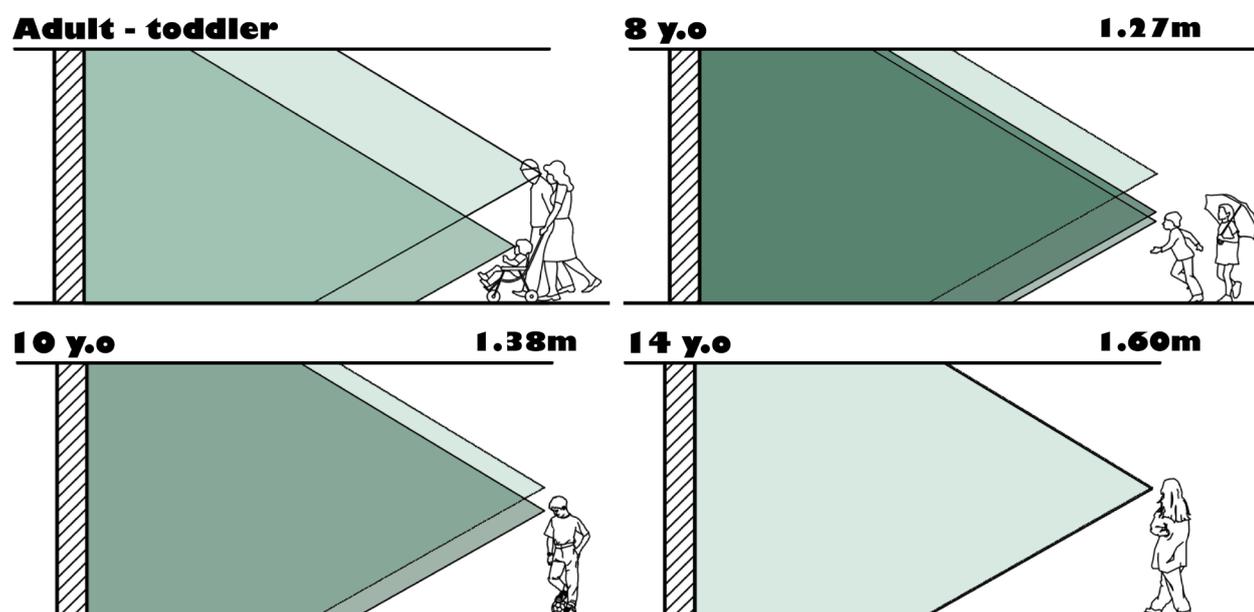


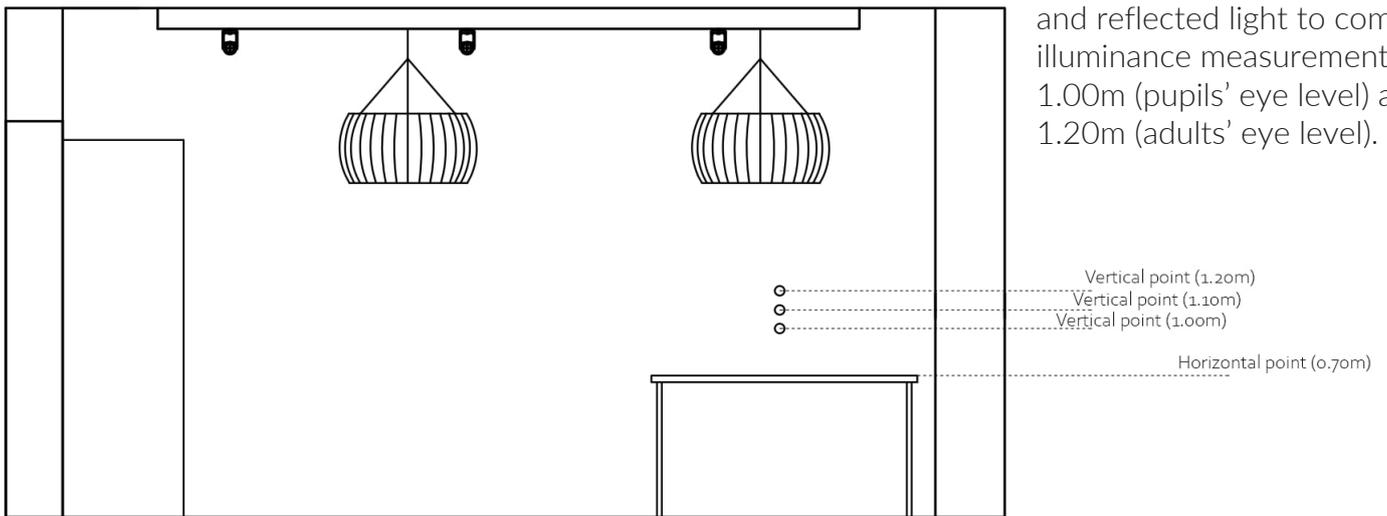
Figure 1: Variations in eye level height across different ages. Information on the average height for different age groups was gathered from reports by the World Health Organization (WHO, 2007).

Links to published reports

- Activity-based lighting for schools: A design handbook (<https://zenodo.org/records/14918184>)
- Electric lighting for classrooms: Photometric and energy use calculation for four lighting fixture and layout alternatives (<https://zenodo.org/records/15740514>)

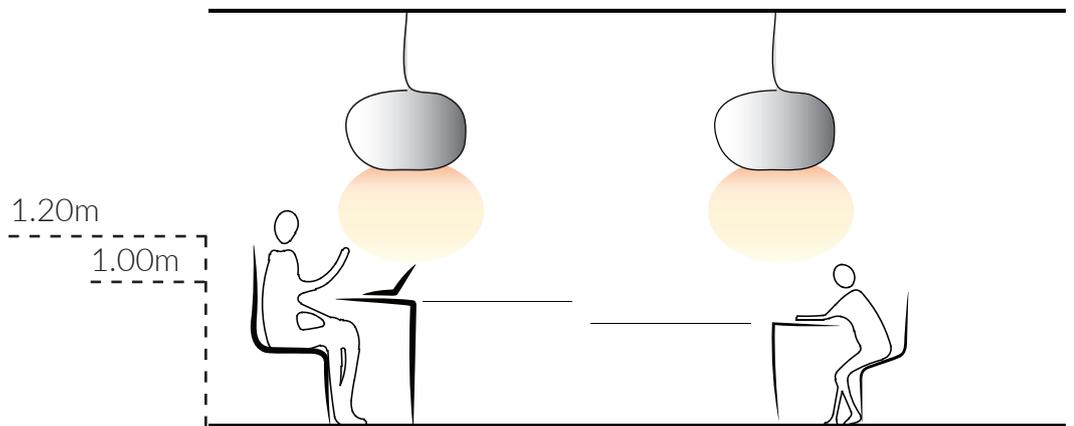
Take away concepts

Office space at KTH campus. We tested different combinations of directional and reflected light to compare illuminance measurements at 1.00m (pupils' eye level) and 1.20m (adults' eye level).



Directional lighting

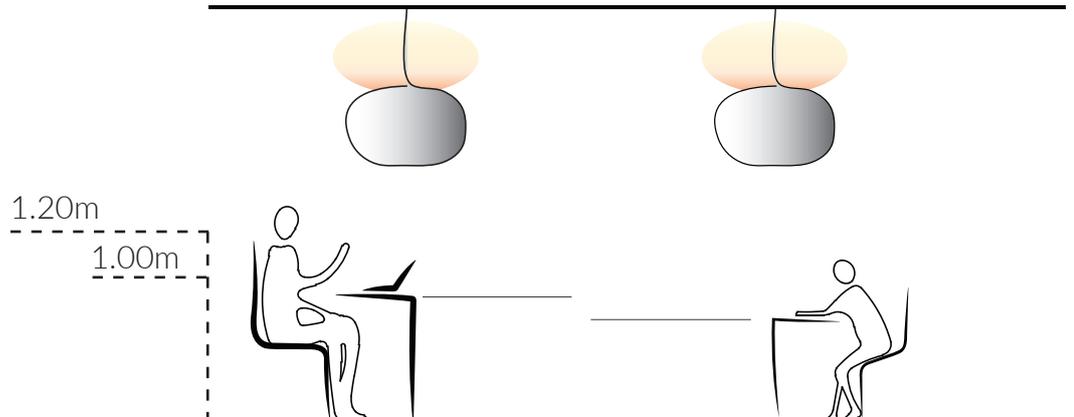
Vertical illuminance was 2-11% higher at 1.00m for the same horizontal illuminance.



How can we use these

Reflected lighting

Vertical illuminance was up to 6% lower at 1.00m for the same horizontal illuminance.



Properly designed reflected light can be used to achieve required horizontal illuminance based on lighting guidelines without over lighting on a vertical plane.

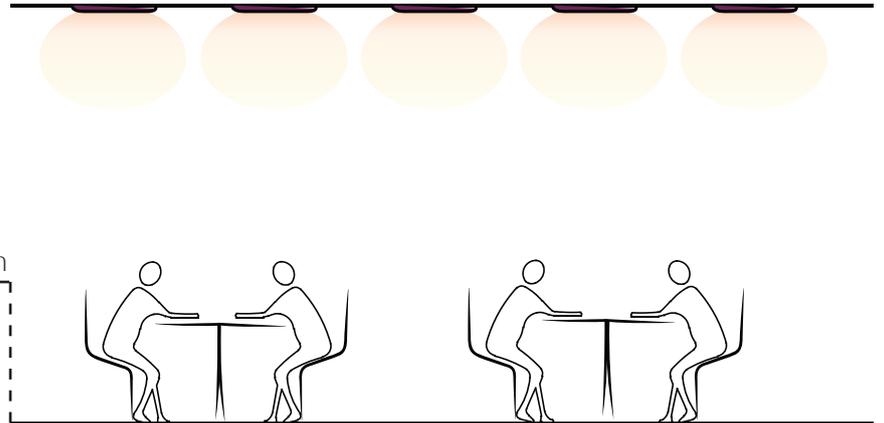
The findings on variations of vertical illuminance can inform official documents (Lighting Standards), redefine the procedure for lighting evaluations in educational facilities and become the basis to differentiate lighting for different age groups.

Take away concepts

Installation at the school and comparison of illuminance and pupils' performance data before and after the new lighting. Daylight was not blocked during data collection. The field study lasted for two academic years, and the installation took place during the second year.



1.00m

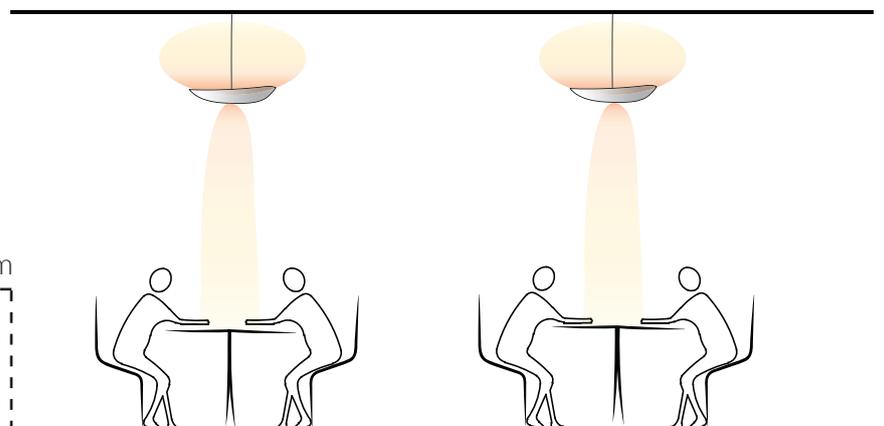


Baseline (Year 1) - Intervention (Year 2)

- monitored light, noise, temperature



1.00m



Pupils' attention performance improved significantly after the lighting intervention, with light identified as the strongest contributing environmental factor.

The study mapped common classroom activities and the corresponding equipment for each activity (e.g., books, papers, laptops).

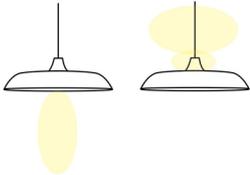
The analysis suggests that a single fixed lighting solution might not be sufficient for all learning activities.

- Group work and discussions benefit from vertical illumination that can support facial recognition.
- Laptop-based work requires controlled brightness and indirect light to reduce glare.
- Reading and writing need balanced desk lighting without strong contrasts.
- Video-based activities can benefit from softer vertical illumination.

2. Individual work

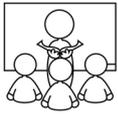


- light on the desk (less directional lighting for laptop screens to avoid reflections on the screen)



Preferred for certain visual tasks, particularly for on-desk tasks. .

3. Presentation



- indirect illumination
- no task lighting
- vertical lighting on the walls (reduce contrast between monitors and immediate surroundings)

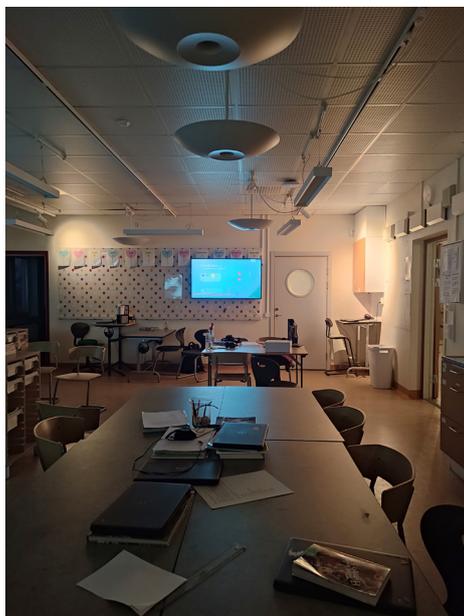


More relaxing and less intense light in space. One of the teachers reported less eye strain.

5. Movie



- only vertical illumination on the walls
- lighting closer to the monitors to reduce contrast



Used for transitions between activities and video screenings.

A teacher reported that this scene is distinct compared to the rest as the contrast and illuminance are visually different.