

## School lighting – an efficient way to improve our children’s education and well-being

A report by

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An interesting study has been carried out in the USA into the relationship between lighting and performance in schools (Heschong *et al*, 2002). Researchers compared the results in classrooms with and without daylight and found that children learned significantly more when there was daylight in the room. The study concluded that this may have been due to better vision as a result of one or more of the following factors:

- higher illumination levels
- better colour rendering
- improved spectral content of daylight
- improved three-dimensional modelling with highlights and shadows
- reduction of flicker from electric lighting
- improved student and/or teacher morale or performance due to:
  - mental stimulation from varying lighting conditions
  - the calming effect of contact with the natural world (weather, time of day)
  - greater mental alertness due to circadian biochemical response to daylight (neurotransmitter levels).

Although this study focused on daylight, most of these factors also apply to artificial lighting as well. Good lighting design can improve our vision, alertness and mood and prevent problems such as glare and flicker.

### **To see or not to see?**

The most obvious purpose of light is to enable us to see. In theory, the more light you have, the better you see, the faster you can read, etc. – as long as there is no glare. Present norms (EN 12464-1 – *Lighting for indoor workplaces*) prescribe minimum maintained levels for schools. These are absolute minimum levels, and higher illuminances are always recommended. The purpose of the norms is to ensure that the basic minimum visual requirements are met. It is important to note that if classrooms are used for a number of different purposes, e.g. for school activities for children during the daytime and for evening classes for mature pupils at night, the lighting needs to be designed for the ‘worst-case’ scenario. In order to optimise visual performance in classrooms we have to illuminate those areas that need to be seen, such as the desktops and the blackboard. The (vertical) illuminance (or luminance) determines how well we can see people’s faces and expressions. It is also very important to make sure that the vertical illuminance is high enough in the area where the teacher will be standing.

### **Sleeping or learning?**

Circadian rhythms are changing patterns that cover a period of approximately 24 hours. These rhythms relate to body temperature, alertness and the secretion of hormones like melatonin and

cortisol. Our biological clock is located in the suprachiasmatic nucleus and is synchronised by ocular light (Brainard and Bernecker, 1995).

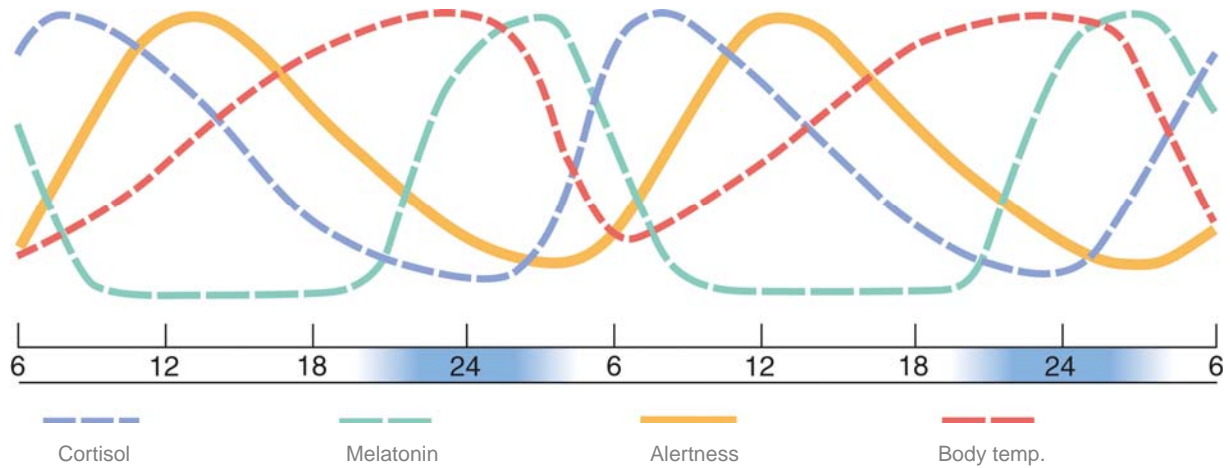


Figure 1. Double plot (2 x 24 hrs) of a typical circadian rhythms including alertness for a natural 24 hrs light-dark cycle

We are less alert in the morning and early afternoon. Research has shown that subjective alertness and speed scores for visual search tasks are lower in the early morning. Since exposure to light in the morning affects the cortisol level in the body, and higher lighting levels also affect the electroencephalogram (EEG), making people more alert, exposure to higher levels in the morning is one way to prevent sleepiness and to improve learning. Pupils who learn in the daytime therefore benefit from increased lighting levels, particularly in the morning and during the ‘post-lunch dip’ (van den Beld, 2002).

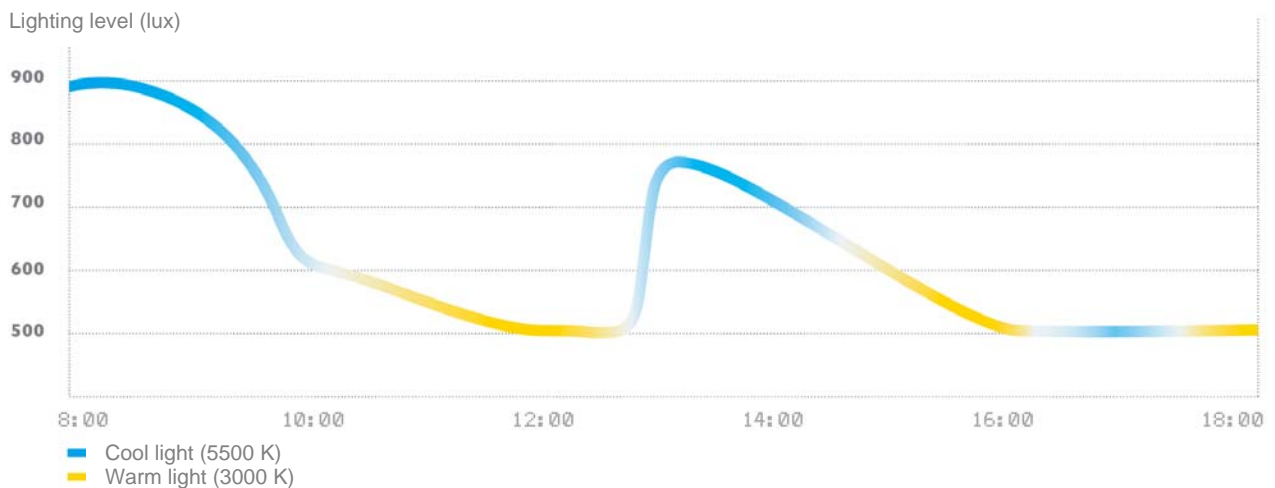


Figure 2. Conceptual lighting algorithm of activity during day time

### **Impact on well-being**

With lighting, there is often a right and a wrong way to do things. A typical example, though not related to visual performance, is the flicker from magnetic ballasts, which can cause headaches and eyestrain, for instance (Wilkins *et al*, 1989). These problems disappear when the magnetic ballasts are replaced by electronic ballasts, which are also more energy-efficient.

In recent years we have gained a much better understanding of how lighting affects people. One example is the relatively alarming information about the connection between poor lighting and the development of myopia. Wolbarsht (2002) summarizes: "Higher lighting levels of ambient illumination produce smaller pupils with increased depth of focus and mean less accommodation is required for near objects. Thus, illumination levels that are sufficient to produce a small pupil when a person is reading or watching television – 2-3 mm or less – could be expected to prevent myopia from developing. In any event, children should be discouraged from using task lighting instead of ambient lighting. Classrooms should therefore be brightly lit, children should watch TV with the main room light on and should not do their homework using task lighting alone."

### **Should school be a nice place?**

Boyden (1971) distinguishes between 'survival needs' and 'well-being needs' in humans. Most of our survival needs are fulfilled in a working environment, but failure to satisfy well-being needs can cause psychosocial maladjustment and stress-related illnesses. People – including children – need: "A visual environment that is interesting, that has aesthetic integrity and in which a certain amount of change meaningful to the observer is taking place". There is a direct link between this need and lighting. Ultimately, it is the lighting that determines the visual appearance of the space in which we find ourselves. And put quite simply, we feel better if we are in a nice environment. Important performance-related benefits of a positive mood include a willingness to help others, better memory, more efficient decision making, increased innovation and creative problem-solving ability (Isen and Baron, 1991). All of these are very important issues in schools. The environment in a school is therefore crucial, and lighting has an essential role to play.

Key steps towards better school lighting include ensuring that the lighting exceeds the recommended minimum levels, that only electronic gear is used, and that high levels of installed lighting are applied in conjunction with lighting controls to deliver the right amount of light in the right place at the right time.

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