

The Effect of School Lighting on Children’s Health, Concentration & Psychology

1. The Problem

Lighting in schools is often designed only for visual tasks, without considering the biological and psychological impact on children. Poor lighting parameters—such as low CCT (too warm, yellowish light), inadequate CRI, high flicker, excess glare (UGR), insufficient vertical illuminance, and lack of melanopic EDI stimulation—can negatively affect students’ concentration, circadian rhythm, mood, and academic performance. Children are especially vulnerable because their eyes transmit more blue-rich light to the retina compared to adults, making their biological systems more sensitive. Inadequate or improperly designed lighting can cause eye strain, fatigue, reduced alertness, headaches, poor sleep regulation, and even behavioral problems.

2. The Idea

The idea behind this study is to analyze and compare key lighting parameters (CCT, CRI, Flicker, Glare, Lux, Vertical Illuminance, Melanopic EDI, Exposure Duration) to determine their impact on concentration, biology, and psychology of students across different age groups. By identifying the difference between good lighting values (recommended standards) and poor lighting values (common in outdated schools), we can understand how lighting design directly influences student health, attention span, mood stability, and learning outcomes.

3. The Study

Comparisons of Parameters

Parameter	Poor Values → Effect	Good Values → Effect
CCT (Color Temperature)	Too low (<3000 K): sleepy, lowers alertness. Too high (>6500 K): harsh, stress.	4000–5000 K: improves concentration, reading fluency, alertness. Tunable: warm for breaks, cool for studying.
CRI	Low CRI (<70): colors unnatural, reduces comfort and engagement.	High CRI (≥80–90): improves visual clarity, reduces eye strain.

Flicker	High flicker (>30%): headaches, stress, worsens behavior in sensitive children.	Flicker-free LEDs (<1%): stable vision, improved attention.
Glare (UGR)	High glare (UGR>22): eye fatigue, distraction.	Low glare (UGR<19): comfortable learning, sustained focus.
Lux (Illuminance)	Too low (<200 lux): dim, poor reading. Too high (>1000 lux): over-bright, discomfort.	300–500 lux on desks, 500–750 lux in labs.
Vertical Illuminance	<200 lux: insufficient circadian stimulation.	≥300–500 lux: circadian entrainment, alertness, mood regulation.
Melanopic EDI	<125 lux: poor circadian stimulus, low mood.	≥250 lux: better circadian alignment, sleep quality.
Exposure Duration	Short/irregular: disrupted rhythm, drowsiness.	≥2–4h good light daily: stable circadian rhythm, energy regulation.

4. The Solution

Lighting should be age-specific and environment-specific, since young children, adolescents, and adults have different visual and biological needs. Here's a recommended guideline:

Kindergarten / Early Childhood (3–6 years)

- CCT: 3500–4000 K
- CRI: ≥90
- Lux: 300–400 lux
- Vertical Illuminance: ≥300 lux
- Melanopic EDI: ≥250 lux
- Flicker: <1%
- UGR: <19
- Exposure: ≥3h daylight

Primary School (7–12 years)

- CCT: 4000–5000 K (3500 K for breaks)
- CRI: ≥85
- Lux: 300–500 lux
- Vertical Illuminance: ≥350 lux
- Melanopic EDI: ≥250–300 lux
- Flicker: <1%

- UGR: <19
- Exposure: ≥ 4 h circadian-effective light

Secondary / High School (13–18 years)

- CCT: 5000–6000 K morning, 4000 K afternoon
- CRI: ≥ 85
- Lux: 500–750 lux
- Vertical Illuminance: ≥ 400 –500 lux
- Melanopic EDI: ≥ 300 lux
- Flicker: <1%
- UGR: <19
- Exposure: ≥ 4 –5h circadian light

Laboratories / Technical Rooms

- CCT: 5000–6500 K
- Lux: 750–1000 lux
- CRI: ≥ 90
- UGR: <16

Libraries / Relax Zones

- CCT: 3000–3500 K
- Lux: 200–300 lux
- Vertical Illuminance: ≥ 200 lux

Playgrounds / Outdoor

- Natural daylight exposure encouraged
- Melanopic EDI >1000 lux for strong circadian benefits