Future-proof tunable white lighting is a smart choice for classrooms

A conversion to LED-based solid-state lighting will of course reduce energy and maintenance costs for schools, but implementing tunable lighting and controls will increase the savings impact as well as enhance the learning environment for years to come.

"Everything we thought we knew about lighting has changed over the past five years. "The sources, the energy requirements, the controls, lifetime, efficacy, color options, form factors - everything!" LED technology has pulled lighting into a dimension with several exciting new opportunities and many emerging cutting-edge developments.

The biggest challenge affecting lighting decisions today is future proofing. Choices made today will likely have an impact over the next 20 or perhaps even 40 years.

For example, we can expect the best LED lighting available today to maintain 90% of initial light output for 100,000 hours or more. Compare this to a fluorescent lighting system that needs regular maintenance after only 30,000 hours due to lamp burnouts.

The simple act of choosing an LED system over a fluorescent one alone can begin to reduce lifecycle costs by saving future maintenance costs.

However, the choice of LED over fluorescent is just the beginning. Let's look at other future-proofing decisions that should be considered when choosing your next lighting system.

Future-proofing basics

The concept of future proofing a space is especially relevant for educational facilities, where public and private investment carry an expectation of longevity and valuable service to children, young adults, and the community at large over several generations. The goal is to specify state-of-the-art systems set in place now that are flexible enough to maintain all their value (by meeting the needs of educators and the community) for decades.

Every future-proof lighting system should create and maintain value for students, teachers, and the school district.

Basic future proofing creates value for teachers by enhancing the teaching experience, and it is cost effective and easy to implement.

These are the must-have basic concepts that add immediate value to the teaching experience:

• Lighting controls built specifically for teacher activities

• Switching modes to support better viewing of projector and media devices

• Vertical lighting of classroom surfaces (white boards)

• Dimming down to 10%

Education has moved from a predominantly lecture-oriented style to a more multi-faceted approach. Activities range from independent projects to small groups and student-led presentations. These are in addition to traditional lecture-style teaching. All of this often happens in a single classroom, within a single day.

Lighting controls built specifically for teaching support collaborative learning and technology in the classroom.

Classrooms have moved well beyond the on/off switch at the door. Published findings have been used by the Collaborative for High Performance Schools (CHPS) and LEED (Leadership in Energy and Environmental Design) to develop best practices for classroom lighting.

Manufacturers are supplying systems with distinct modes for white boards, audiovisual systems, group activities, test-taking, and tablet usage. While there may still be a toggle switch at the door, these more granular controls have been relocated to where the teacher is centered, usually at the nominal front of the classroom.

These controls add vertical lighting on teaching surfaces to improve visibility and direct student attention. They also support a teacher's need to act in the moment while maintaining the attention of the class.

Classrooms have become more flexible, and we see that learning takes place everywhere. Bean bags in the corner and sofas under the windows invite small group discussions. Desks and tables are moveable for more fluid classroom layouts. New technologies abound: multiple white boards and writeable walls; flat-panel displays; tablets and handheld devices; streaming and interactive content; group audio-visual presentations; and video conferencing.

Future-proof lighting provides switching and dimming modes that help direct the attention of the students; these modes also improve the viewing of projector content, computer screens, and media devices.

Creating value for teachers

Cutting-edge concepts that are likely to become the standard in the classroom of the future include: color tuning; using lighting to cue behavior and lesson plans; ensuring color quality with high-CRI lighting; delivering 1% dimming; and providing app-controlled lighting for teachers.

Two-source tunable-white LED light employs pairs of LED chips-one cool and one warm-that are blended to produce a range of white light that can be easily controlled.

The DOE established the following requirements for the lighting and controls: luminaires must be energy efficient (120 lm/W); the teacher must be able to control intensity and CCT; daylight and electric light

must be balanced; control is both local and central; and both vertical and horizontal illuminance levels are used to ensure excellent quality light.

Teachers have been using light intensity to control behavior for some time now, for example, flicking the on/off switch to get students' attention or dimming the lights to calm them down. Tunable white technology adds color temperature to this equation. Researchers are still working to quantify the impact of CCT on behavior, but, as Naomi Miller, a research scientist at Pacific Northwest National Lab, has observed, "whiter, bluer lights in higher intensities may tend to wake us up, and lower, warmer colors may tend to calm us down...".

Teachers are highly individual with their own teaching style. Some use AV extensively, others encourage student-led presentations, while some may place a strong emphasis on group work. As such, lighting needs to be customizable.

Creating value for school districts

Basic future proofing saves money and improves learning experiences for students and staff. Schools will need guidelines to get started - and installing LED lighting systems is the first step. They are affordable, save energy, and reduce maintenance costs.

LED technology uses less energy and requires less maintenance, improving lifecycle cost compared to fluorescent technologies.

Choosing a quality LED lighting system that lasts decades is critical; it should be virtually maintenance free and warrantied for at least 10 years.

 Lighting design is just as important, and best practices include ceiling lighting and vertical lighting to improve the lighting quality and save energy by delivering the most efficient light in the right places.

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Using this approach can cut lighting power densities in half compared to current energy codes. Energy savings can be further increased with occupancy sensors, daylight sensors, and basic dimming controls.

Cutting-edge concepts further extend the functionality of a lighting system. Methods to improve system management include advanced trim settings, scheduled lighting cues for tunable white light, and networked lighting that is controllable from the central office or district level and allows for system interoperability. All of these factors can impact the management of appropriate lighting levels in classrooms, simultaneously saving energy and extending the life of the system. Furthermore, a tunable lighting system can be designed to provide circadian entrainment of students to school schedules that are not in sync with the natural solar day.

The average age of schools in the US is 44 years, and the average age of significant renovations in schools is almost 20 years. As we learn more about the impact of CCT on health and behavior, institutions that invest in tunable white now will be ready to face the future.