Luminaires for Advanced Lighting in Education

Recap of DOE Award Number: DE-EE0007081

Recipient: RTI International | Teaming Partner: Finelite, Inc.

FINELITE® Better Lighting

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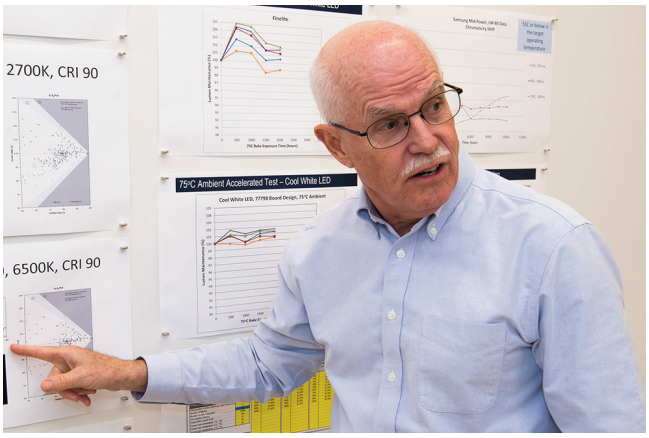
Opportunity

Today's learning environments are continually evolving spaces and need lighting solutions that do more than brighten a space. Research indicates that lighting systems with the ability to easily adjust the color and illuminance levels to the task at hand will enhance the learning experience. In 2015, The Department of Energy requested a complete lighting system be created to support the needs of the Classroom of the Future with a strong focus on user-control, reliability, and energy-efficiency. RTI International and Finelite, a company dedicated to research and advancements in classroom lighting, submitted for proposal to build the system that would better the learning environment.

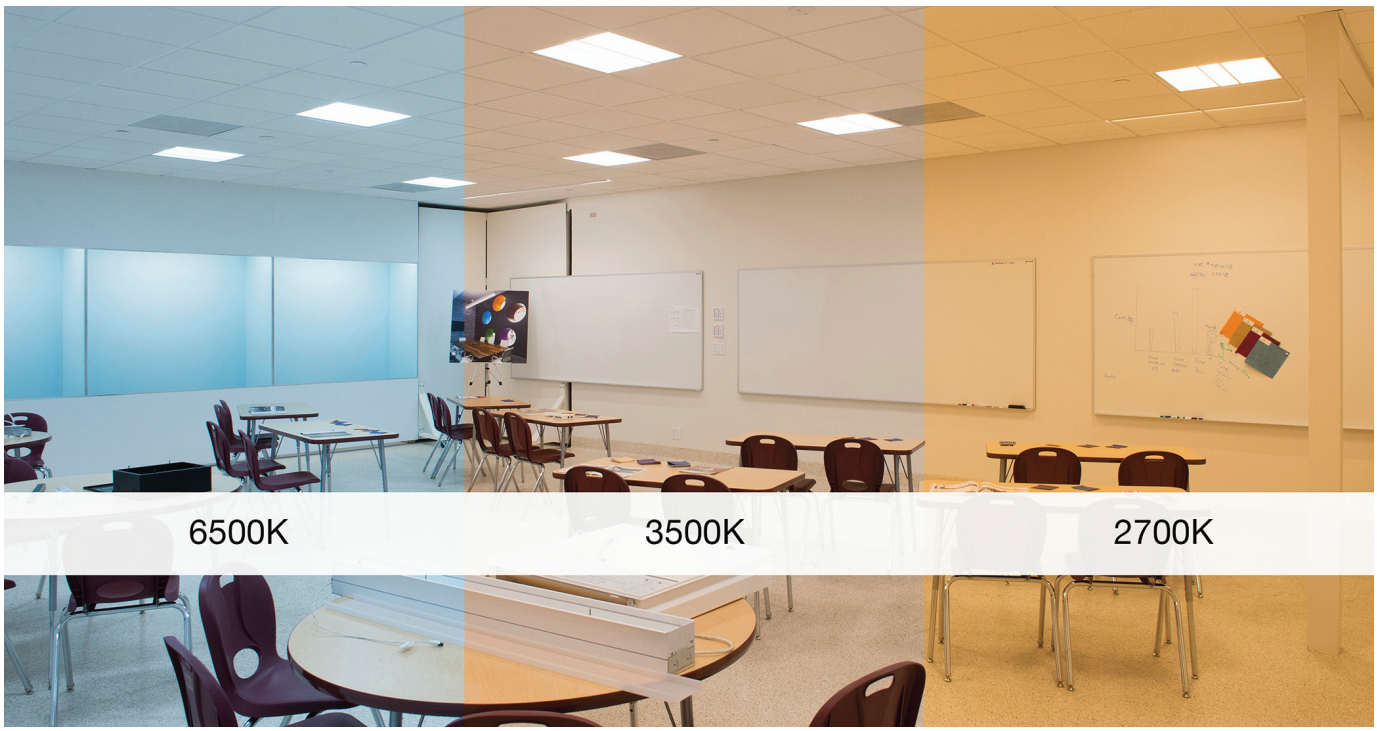
Research

RTI International and teaming partner Finelite, Inc. were granted the U.S. Department of Energy's funded-research project "Luminaires for Advanced Lighting in Education," and developed the Next Generation Integrated Lighting System (NICLS) for the Classroom of the Future.



Terry Clark, founder of Finelite, explaining metrics in the DOE research classroom for educators.

Finelite built a model classroom with luminaires and controls. RTI led research and performed accelerated stress testing over extended periods of time in extreme conditions to verify the system and device wear-outs. Over a 12-month period, more than 80 teachers and school administrators participated in focus groups held at Finelite's demonstration site. The purpose was to provide guidance on the use of the advanced lighting technologies in the classroom and gain user input on the design of the user interface (UI) for the lighting control system.



DOE research classroom

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Key Findings

Report findings show that the Finelite luminaires never reached the point of wear-out for lumen maintenance, chromaticity shift, and luminaire drivers during any of the elevated ambient and forward current testing. The system and system componentry displayed the long-term reliability demanded by the DOE.

Aggressive performance goals by the DOE for this project were established for luminaire performance, energy savings, lifetime expectations, flicker, tunability, and control. The project met or exceeded every photometric, electrical, and reliability goals established by DOE for an advanced lighting system for educational environments.

Below are the key findings:

- Demonstrated a luminous efficacy value for NICLS luminaires in excess of 125 lpw at all CCT values
- Demonstrated a TWL range of 2,700K to 6,500K while maintaining a CRI of 83 or higher at all values
- Provided the capability for full-range dimming (100% to 1%) at all CCT values with flicker levels below industry guidelines, such as Institute for Electrical and Electronics Engineer recommended practice P1789, and compatibility with American National Standards Institute C82.77 requirements for luminaires
- Incorporated daylight and occupancy sensing to provide automatic control of lighting zones to further reduce energy consumption
- Achieved a rated lifetime on the system exceeding 50,000 hours with a lumen maintenance of at least 85% at 50,000 hours
- Created a teacher-focused user interface (UI) located at the front of the classroom to operate the lighting system and a mobile app for advanced control based on user input from structured focus groups

Conclusion

A well-designed lighting system will improve not only teacher effectiveness but also a student's ability to concentrate on tasks or calm down and decompress, as needed. Early research on the correlation between the color of illumination, as measured by CCT, and student performance has been promising. The research has shown that students' concentration increases when lighting with higher CCT values is used and that students' levels of relaxation and calmness are increased by lighting set to lower CCT values. The NICLS technology has been demonstrated at the classroom level, and the feedback from teachers and educational professionals who visited the demonstration site has been overwhelmingly positive.

The energy savings that could be realized by installing the NICLS technology in a classroom are significant, but the larger long-term gains are likely to come from the benefits to the community of having higher performing schools and better-educated citizens.

The findings conclude that the investment in advanced SSL systems for educational facilities is one that should be seriously considered.

Glossary

(CCT) **Correlated Color Temperature** - CCT is defined in degrees Kelvin (K); a warm light is around 2700K, moving to neutral white at around 4000K, and to cool white, at 6500K or more

(CRI) **Color Rending Index** - the Color Rendering Index (CRI) is a scale from 0 to 100 percent indicating how accurate a "given" light source is at rendering color when compared to a "reference" light source. The higher the CRI, the better the color rendering ability

(LPW) **Lumen Per Watt** - refers to the energy efficiency of lighting: how much visible light you get for a given amount of electricity

(NICLS) **Next Generation Integrated Lighting System** - research name for the lighting solution to better the learning environment that's provided by one party and backed by a single-source warranty

(SSL) **Solid State Lighting** - a type of lighting that uses semiconductor light-emitting diodes (LEDs), organic light-emitting diodes (OLED), or polymer light-emitting diodes (PLED) as sources of illumination rather than electrical filaments, plasma, or gas

(TWL) **Tunable White Lighting** – ability to adjust the correlated color temperature (CCT) and intensity of the source independently

(UI) **User Interface** - a wall mounted control station that easily provides the ability to shift light color, intensity, or scene quickly with minimal effort