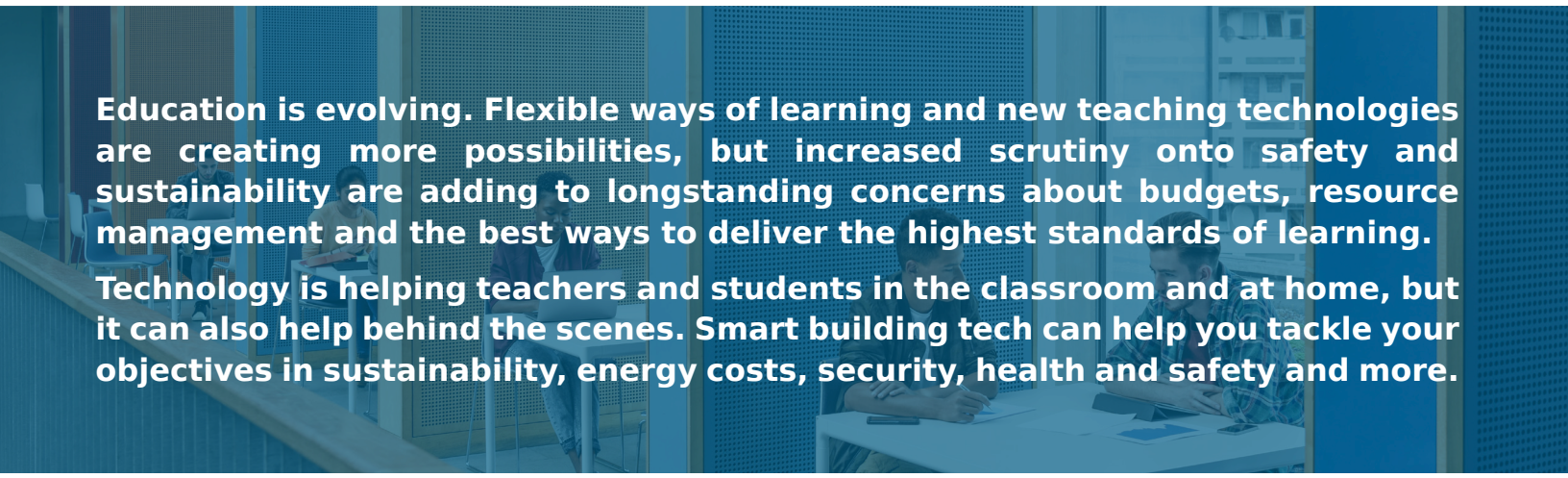
APPLICATION BRIEF

molex

Investing in the future of education with smart building technology ›



Education is evolving. Flexible ways of learning and new teaching technologies are creating more possibilities, but increased scrutiny onto safety and sustainability are adding to longstanding concerns about budgets, resource management and the best ways to deliver the highest standards of learning.

Technology is helping teachers and students in the classroom and at home, but it can also help behind the scenes. Smart building tech can help you tackle your objectives in sustainability, energy costs, security, health and safety and more.

Creating optimal learning environments

There is an increasing amount of research linking student achievement and the environment in which they learn. Students in "poor" buildings – ones with inadequate HVAC systems, poor lighting, are noisy, etc – can score between 5-10 percentile rank points lower than students in functional buildings. The three criteria that most impact student achievement are temperature, indoor air quality and lighting.

Temperature control

For HVAC systems to control temperature effectively, local information is required. While broad trends can be predicted, actual temperatures can vary across a building due to a number of factors – current occupancy levels, whether windows face into direct sunlight, differing thermal qualities of construction, airflow and others. Temperature can even vary across larger rooms. Specific working temperature recommendations vary, but in general the temperature should be kept between 68°F and 76°F / 20°C and 24°C. This is a narrow window for control.

The essential starting point is implementing a system to gather real time data using multiple sensors. Data alone analyzed over time can provide invaluable insight into the scale of the issue – how many areas find themselves outside the acceptable temperature range, and how often? Note that, due to airflow and temperature differences across rooms, data from existing thermostats may not be helpful, as they may have been positioned primarily for ease of access.

Once data is available, it is possible to develop an appropriate plan. For

less severe issues, small adjustments of existing settings may be enough to move conditions back into the acceptable range. Using window blinds to block sunlight at hotter parts of the day can reduce heat gain by up to 45%. For more serious cases, it may be necessary to look at the capabilities of the HVAC system. Integrating it into a smart building system would allow it to respond directly to the real-time sensor data, enabling it to react to unexpected changes in conditions.

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Conditions in a classroom can significantly impact student performance

Air Quality and Student Health

Since 2020 we have all become much more aware of the effect of buildings spaces on our health, and studies have confirmed a link between particle count and absenteeism. As well as dust and pollutants, airborne bacteria and viruses and even VOCs released by everyday textiles can impact allergies, respiratory conditions and general health. Air conditioning circulating systems usually include some sort of HEPA filter, but these are often designed to protect the HVAC unit rather than maintain indoor air quality (IAQ), and standard HVAC filters won't capture bacteria and viruses. In addition, HVAC systems typically respond to changes in air temperature, not quality – so airborne contaminants can easily build up while the system is on standby.

Air quality sensors can measure a variety of different specific parameters, including particles, CO2 and VOCs. They can be built into light fittings or installed as standalone sensors. This provides real-time information on air quality levels in different locations and at different times, helping you to identify potential problems as areas are occupied and become empty again. Combined with occupancy data, this can help staff understand where schedules can be adjusted to give air time to changeover, where HVAC filters could be upgraded, and which locations will need more cleaning.

Airborne bacteria and viruses, dust, pollutants and even VOCs released by everyday textiles can impact allergies, respiratory conditions and general health

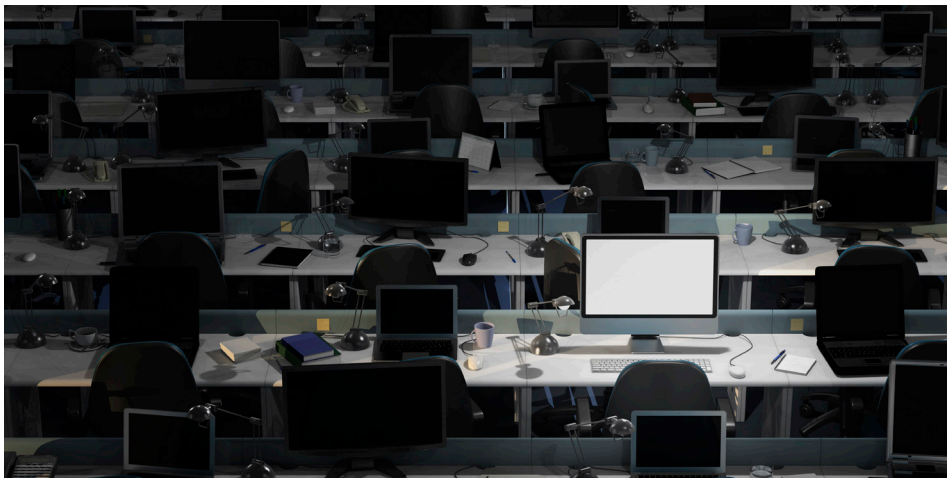
Another solution is to implement air purifiers designed specifically for the purpose of improving IAQ. These use a combination of filtration and disinfection technologies to capture and eliminate a much wider range of airborne contaminants. By connecting the air purifiers to the smart building system, they can become smart and modulate the rate of air flow in response to the air quality or occupancy levels at that moment. This ensures air quality does not suffer as a result of crowded lectures, rush hour pollution, or seasonal high pollen counts.

Smart Lighting – Automatic Control and Daylighting

Light is a critical factors for student performance. Insufficient light can lead to eye strain, sleepiness and depression; too much light can result in headaches. The type of light is also an important factor, with students in schools with daylighting scoring significantly higher on achievement tests.

Smart lighting is a core component of most smart building systems. Reacting to brightness, time of day and lighting temperature, artificial lights and window blinds can be automatically controlled to ensure optimal conditions are maintained. Where daylight is not available or unreliable, biodynamic lighting can automatically match the natural shift in lighting color throughout the day to provide an environment that feels more comfortable.

Smart lighting control creates other opportunities for enhanced learning. For example, the color or "temperature" of light has been shown to favor different types of activity, with cooler blue tones being more suitable for quiet study and concentration, while warmer tones are better suited to creativity. Lighting can be tied in to intercom or alert systems to provide notice of an incoming message, to signal the end of a lesson, or for other



Smart buildings can switch off equipment that's been accidentally left on, saving energy

types of communication. Local controls can enable teachers and students to adjust setting to their own preferences for the duration of the lesson, with the smart system resuming control at the start of the next session.

Safety for Students and Faculty

Schools have a duty of care to maintain a safe environment for students and faculty, but the scope of what this actually entails has broadened significantly in recent years. ID cards, digital access controls and a dedicated security presence are now common at many places of learning. As campus populations expand, emergency situations and procedures need to be communicated clearly to ensure everyone takes the right action.

Smart Emergency Systems

A basic emergency system comprises three essential elements: an audible alarm, emergency illumination, and predetermined safe routes away from danger. But while this simple communication tells us something serious is happening, it doesn't give us much detail. Our actions might be different if the emergency is a fire or an earthquake. A different emergency evacuation route might be safer. Occupants with hearing issues might not be aware of an emergency at all.

A smart building system can offer a range of options to help occupants get to safety. For example, it could set the main lighting fixtures to a different color or flashing pattern to indicate the specific threat. It might be able to dim or brighten emergency lights to signpost the best way out. It could automatically take control of speakers and AV equipment to transmit instructions across the entire campus simultaneously, or to those areas affected. Lights and devices can be powered by backup or uninterruptible power supply to ensure they remain functional and under control even if mains power is lost.

Lighting alone accounts for 17% of the energy consumption of a typical building

Improving Energy Efficiency

Globally, real estate is one of the major consumers of energy and producers of CO2 emissions. They are also typically very inefficient. HVAC typically consumes 40% or more of a commercial building's energy, but a third of HVAC systems are oversized for the space they are serving. Lighting accounts for about 17% of the energy consumption of a typical commercial building , and converting to smart lighting is often the starting point for a broader smart building solution as this is an easy "quick win". LED retrofits alone can achieve 30% energy savings, while implementing advanced lighting controls can offer an additional 44% energy savings with a payback of less than five years.

Smart buildings aren't limited to saving energy from the building itself, however. Energy drawn by equipment connected to mains power outlets is often significant contributor to expenses: in a 2015 study of Stanford University's campus, plug loads were estimated to comprise 32% of the energy consumed. "Vampire" or "phantom loads", energy drawn by equipment that's inactive or in standby mode, accounts for 33% of mains energy use in commercial buildings. This includes computers and printers on standby, device chargers, projector systems and even kitchen equipment like microwaves. Measuring the draw of power of hundreds or thousands of devices across departments and buildings can be difficult and this area is often overlooked in energy efficiency drives.

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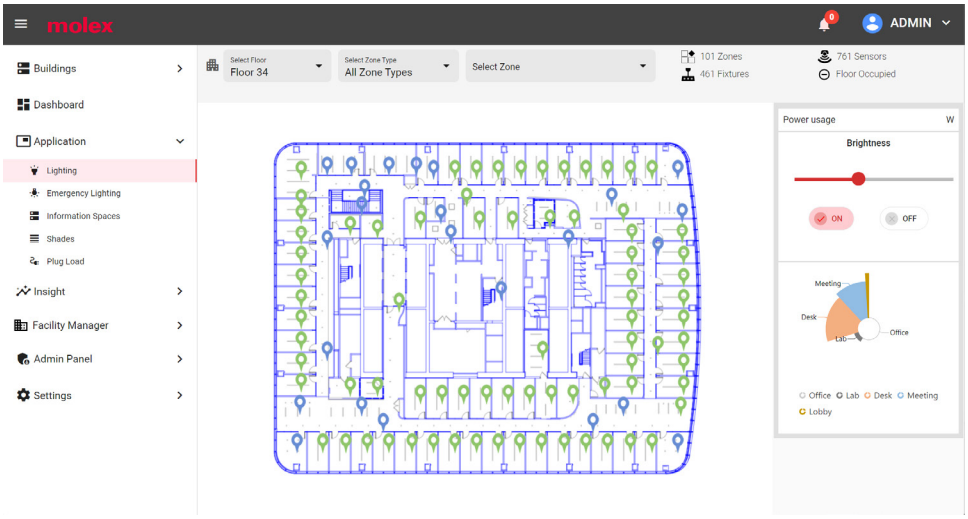
Using smart plug receptacles or power relays, the draw of power can be measured and understood on a granular level so that facility managers can understand exactly where energy is being wasted. A smart building system can manage and visualize this information. It can also remotely turn power on or off on a zone to zone or even plug to plug basis, so that essential equipment like freezers and servers remain powered while photocopiers, audiovisual equipment and microwaves are powered down when they are not likely to be needed. This can be done on a preset schedule, so that equipment powers down over the weekend or at night; in response to real-time occupancy information; or a combination of both. By timing the schedule accurately, power can be automatically switched on in advance of a scheduled meeting or class to allow time for equipment to warm up.

Saving Energy, Reducing Costs

Sustainability is not just a matter of principle. Cost reduction through energy efficiency is often one of the biggest selling points for smart building installations. According to the American Council for an Energy-Efficient Economy, education buildings in particular could reduce their energy use by 11% by utilizing smart building technologies. As well as the long term benefits of reduced running costs, the financial savings may be leveraged to subsidize or underwrite the cost of the installation. One strategy is to implement smart lighting first, and use the cost savings from this to finance additional functionality.



Visualizing data in a smart building dashboard

Increasingly, governments are incentivizing building operators to go green: for example, US states like Maryland, New Mexico, New York and Virginia have programs in place to reward buildings and communities making efforts to work toward LEED certification. Incentives include expedited review and permitting processes, tax credits, property tax reductions, fee reductions or waivers, grants, and revolving loan funds.

Efficiency in Facilities Management

When we think of the pressures on schools we think first of the teaching staff, but facilities teams feel the strain as well. In a survey, facilities managers in education reported more challenges and had more difficulty addressing them than those in healthcare or commercial real estate sectors.

Even simple smart building systems offer quick wins for facilities teams. There's no need for someone to walk the halls to check rooms are empty if occupancy can be monitored from the control system dashboard. Cleaning schedules can be reduced or eliminated in areas that have not seen any traffic since the last round. On a granular level, even soap and paper towel dispensers can be fitted with sensors so that restocking is only carried out when needed.

Smart-enabled predictive maintenance can be up to 9 time cheaper than a reactive approach

Smart buildings can also offer more strategic benefits. Many facilities teams have to juggle multiple disparate systems, which is time-consuming and makes it difficult to get a holistic view of the state of affairs. A single pane of glass dashboard makes it straightforward to compare different sets of data, to run meta-analyses and to compile reports. API integration enables data from multiple systems and vendors to be drawn together into the smart building's dashboard without the hassle and expense of having to replace existing systems.

Centralized data management also makes it easy for management to generate the reports needed by stakeholders, for example, attendance or occupancy, or on the status of energy saving measures.

Pre-Emptive Maintenance

Broadly speaking, there are two types of maintenance: the type that happens on a schedule at a preordained time, and the type that happens urgently, when something is not working. Scheduled preventative maintenance prevents some but not all system failures, and if something actually goes wrong there can be a delay before someone even notices any problems, let along alerts the facilities teams.

With IoT sensors, feedback is delivered in real time and even slight deviations can be flagged: think a single room failing to meet its set temperature range, or a piece of equipment pulling power intermittently. Investigating an issue early can prevent relatively small, straightforward issues from evolving into something more time-consuming and potentially dangerous. Some estimates suggest that smart-enabled predictive maintenance is 3 to 9 times cheaper than a traditional reactive approach.

PoE-based smart building systems are also able to monitor the status of their own infrastructure, so faults with devices or connectivity are flagged rather than becoming a data black spot.

Focusing on the Future

What schools needed ten years ago is vastly different from what schools need now. Trying to second-guess what will schools need in the next ten years could be an expensive gamble. Instead, schools should plan to build in flexibility and gathering the data to ensure decisions are based on evidence.

Data Driven Decisions

Data is the very thing that makes a smart building “smart”. Sensor feedback is essential for the system to make decisions and take actions. This same sensor data can be used to inform decisions, from classroom schedules to positioning of air filters. Evaluating trends over time can be used to identify where patterns of behaviour are naturally evolving, and to make changes accordingly.

IoT sensors are generally small and inexpensive. Some sensors come preinstalled into fixtures like light fittings or air filters. Standalone sensors that require mains power are more difficult to install and relocate, so look for PoE or self-powered (wireless) devices.

Flexibility

Smart building technology is itself evolving. New sensors, devices and software bring new functionality and new ways to tackle old problems. A smart building is not a device like a TV or an AC unit: it is a system with multiple interlinked components and elements. It can be altered, upgraded, downgraded, repositioned or reconfigured as requirements change. It can be expanded to include more zones or buildings or trimmed down to the areas showing most benefit. A smart building solution will be able to adapt with you to help you achieve your goals as they change.

Conclusion

Education is changing, offering new possibilities but also presenting new challenges. Smart building technology can help with many of these by improving sustainability, saving money, protecting occupants and helping deliver more dynamic ways of learning. With a huge range of options, smart buildings can deliver intelligence and efficiency in the ways that matter you to today and tomorrow.

IoT sensors are inexpensive and easy to install. Clockwise from top right: Environmental sensors, temperature / humidity sensor, occupancy sensor, ambient light sensor

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Molex CoreSync Smart Building Platform

Molex CoreSync is a powerful smart building platform which offers a range of OEM and third-party devices which help you gather and analyze data and automate. With CoreSync, you can easily tailor conditions to create optimal environments for different types of lesson, from exams to presentations to collaboration.

Facilities managers can integrate security, building management and other systems for a single-pane-of-glass view of the building or campus. With granular data, you can analyze data trends over days, weeks or months to identify where efficiencies can be made.

CoreSync is built on PoE (Power over Ethernet), a safe and reliable standards-based technology based on familiar Ethernet infrastructure. PoE delivers sufficient voltage to power a range of sensors and devices, but low enough to be completely safe to handle. Removing the need for qualified electrical professionals makes PoE easy for IT or facilities personnel to install, reconfigure and upgrade as requirements change.

CoreSync smart building platform delivers the functionality you need to create smarter, more responsive educational environments.

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MORE INFORMATION

More information about CoreSync > www.molexces.com/coresync/

More information about PoE solutions from Molex > www.molexces.com/solutions-overview/poe/

www.molexces.com/coresync/markets/education/

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