THE IMPACT OF CLEANING ON **HIGHER ED**

A Study Into The Impact Regular Cleaning And Maintenance Have On Recruitment, Achievement, and Wellbeing on College Campuses

The Importance of Agile, Data-Driven Facilities Operations for Colleges and Universities

This white paper lays out this research, from a cross-section of disciplines, across a wide-range of institutional goals and priorities. By bringing into focus the myriad ways facilities conditions underpin both individual and collective success in higher education institutions, it provides both cautionary tales and a roadmap to success for administrators making decisions under contemporary conditions.

Finding ways to improve the efficiency, accountability, and quality of maintenance and custodial operations can significantly impact operational effectiveness, resource management, long-term sustainability, and overarching morale and engagement.

3 Key Research Findings in this Report

4 Impact Of Facilities On Recruitment & Retention

7 Impact On Student Academic Achievement

10 Impact On Student Health & Wellbeing

12 Impact On The Business Model Of Higher Ed

17 Using Technology to Improve Environments

17 Resources Cited

Research Findings on Impact of Cleaning for Higher Ed

This report discusses the research documenting the impact of facilities maintenance and cleaning has on key university objectives and priorities that are critical to the core mission of Higher Education. These include:

Campus Conditions are Significant in Attracting & Recruiting Students: Research has shown that a majority of students–as many as 2/3–consider the quality of campus facilities a significant factor in their college selection process. Colleges and universities with modern, well-kept facilities are more likely to attract top students.

Facilities Impact Student Retention & Persistence: Studies have documented that the condition quality of campus facilities–and student satisfaction with them–directly impact student retention and persistence to graduate. Colleges and universities that have buildings in poor condition or outdated facilities, poor ventilation, and issues with air quality have higher dropout rates, on average.

Academic Achievement is Correlated with Cleanliness: Research has found a correlation between the cleanliness of a college or university's facilities and its students' academic achievement. And, poor facility conditions get in the way of learning, inhibiting students' ability to focus.

Deferred Maintenance Increases Costs Over Time: Studies have documented that deferred maintenance leads to much higher costs for larger repairs down the line. Because of this, proactive maintenance and upkeep is actually a cost-saving step for colleges and universities.

Poor Maintenance Risks Student and Staff Safety: Studies have shown that deferred maintenance can lead to safety issues and hazardous conditions on colleges and universities. Delaying maintenance leads to liability risks as well as other concerns for student and staff wellbeing.

The Impact Of Campus Facilities On Recruitment & Retention

"From academic major buildings and historic structures to residence halls and gathering areas, a variety of campus facility types and spaces influence enrollment for nearly two-thirds of students."

Inside Higher Ed, December 2022

Clean & Well-Maintained Facilities Directly Affect Recruitment & Retention

Student recruitment is a primary and necessary priority for all colleges and universities, as it affects a school's financial stability, academic reputation, ability to fund and staff a broad array of academic programs, and, ultimately, determines the overall success of an institution.

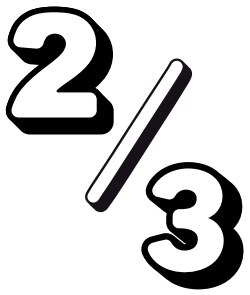
Over the past decade, rates of college enrollment for 18- to 24-year-olds have seen a steady trend downward–the result of a constellation of issues including the rising cost of tuition, disruptions from the COVID pandemic, and shifts and challenges with the Free Application for Federal Student Aid (FAFSA). In fact, between 2010 and 2021, undergraduate enrollment decreased by 15% from 18.1 million to 15.4 million students.

Race/ethnicity and nonresident status	2010	2021
American Indian/Alaska Native	179,091	107,013
Asian	1,029,768	1,098,939
Black	2,677,086	1,947,653
Hispanic	2,551,000	3,306,301
Pacific Islander	57,521	40,972
White	10,895,938	7,828,943
Two or more races	293,663	663,082
U.S. nonresident	398,360	455,517

Though the National Center for Education Statistics (NCES) predicts that some of this enrollment will be recovered over the next ten years, projections still maintain lower enrollments than its peak in 2010. With this backdrop, it is **more important than ever for colleges to be able to appeal to, attract, and retain high-quality students**.

Research has shown that campus and facility conditions and aesthetics play a key role in that recruitment process.

A 2019 study explicitly looking at how facilities impact a student's decision to attend a specific college–as well as decisions not to attend–found that **"a pleasant and attractive campus" was among the five most important factors that influence a student's decision**.



Students consider the quality of campus facilities a significant factor in their college selection process.

Colleges and universities with modern, well-kept facilities are more likely to attract students.

And **this correlation is particularly impactful for students as they narrow down schools they have been accepted to in making their final–more so than in the initial decision-making** about where to apply.

In other words, from the pool of students schools have identified as ones that have met the qualifications to be a good fit, the quality and condition of facilities plays an even more significant role in influencing decision-making.

Retention, Satisfaction, and Drop-Out Rates

Beyond attracting students, studies have shown that the cleanliness and maintenance of a campus affect whether students stay at a particular college or university. Research has documented that the **condition and quality of campus facilities–and student satisfaction with them–directly impact student retention and persistence to graduate**. Student satisfaction is closely intertwined with having a "comfortable learning environment where public spaces and campus accessibility play vital roles."

Academic, residential, and recreational facilities are particularly impactful as those are the places where students spend the most time. In a survey, **a staggering 87% of student respondents shared that the quality of academic facilities were "important or very important" for their continued education.** Library facilities, in particular, have a significant role in the student experience. Studies have found that a large majority of students identify the quality of the library as integrally tied to their satisfaction and decisions to stay in a university setting. In terms of the specific qualities of the library, **"cleanliness" and "comfort"** were both variables correlated with library satisfaction.

Conversely, facilities that are not well-maintained have been directly associated with higher dropout rates. Studies have shown that colleges and universities with **buildings in poor condition, outdated facilities, poor ventilation, and issues with air quality have higher dropout rates, on average.** In classrooms, laboratory spaces, residence halls, offices, restrooms, and hallways the manner in which the facility is maintained signals to community members the care and attention which the institution dedicates to their success.

Institutions with significant research undertakings have historically been able to supplement their operational budget with additional funds for facilities maintenance through administrative overhead billing as part of their grant funding. However, this funding stream will be **significantly altered** under federal grants **after the capping of billable indirect costs at 15% for many federal grants on February 7, 2025.** Historically, these costs have run at over 50% of grant allocation.

This difference will disproportionately come from **a reduction in administrative and maintenance support to maximize available funding** for researchers and direct experimental resources. This will impact the ability of colleges and universities to attract students and faculty unless greater efficiencies can be achieved with the more limited available resources. With this understanding of the relationship, **researchers have advised that improving the condition and quality of facilities can directly impact students' ability to achieve their goals successfully.**

Studies have found that a large majority of students identify the quality of the library as integrally tied to their satisfaction and decisions to stay in a university setting.

The Impact of Facilities' Condition and Quality on Academic Success & Achievement

"The quality of educational facilities significantly influences student satisfaction, learning outcomes, and academic success. A well-designed campus fosters engagement, motivation, and overall achievement."

Hung Thanh Nguyen, "Examining International Student Satisfaction"

Facility Condition & Cleanliness Directly Impacts Achievement & Focus

The primary purpose for students to attend college is to foster learning, growth, and skill development that will set them up for career- and life-success. Research has shown that the quality and condition of a campus and its facilities directly correlate to this mission–specifically on academic learning and achievement.

Studies have noted the direct relationship between the cleanliness of a college or university's facilities and its students' academic achievement. These trends are backed up by a large body of research that has looked at these correlations across the Kindergarten through higher education spectrum. Repeatedly, reviews of research have found "**significant correlations between building conditions and academic outcomes."**

This impact spans grade levels and subject areas–and has been documented with performance on critical state achievement tests. Research from St. John's University explored the nuances of this relationship and found that well-maintained classrooms and common areas improved student concentration and motivation, thus fostering better learning outcomes.

Relatedly, poor building conditions have been found to inhibit learning. In a recent survey of college students, **30% reported that "poor maintenance, cleaning or general building conditions on campus" have negatively impacted their ability to focus and learn.**

That number increased to 50% of students for those who reported particularly bad building conditions like leaky roofs and ignored maintenance requests.

A 2008 study from the Centers for Facilities Research found that a staggering **88% of students in the study reported that a lack of cleanliness resulted in a lack of focus on their studies.**

A robust set of research has shown that specific building conditions including proper lighting, temperature stability and comfort, humidity, and appropriate ventilation, are directly linked to student achievement.

The 2008 Centers for Facilities Research study noted that air temperature, lighting, and overall cleanliness ranked in the top four most impactful variables on student learning.

Because of this, maintenance of the HVAC infrastructure, lighting systems and parts, and the regular cleaning of windows all affect student academic growth and success.

30% → 50% → 88%

Air Quality Has the Most Significant Impact on Cognitive Function and Learning

Research seeking to understand the relationship between building and facilities conditions and student success has spotlighted air quality as a major factor correlating with academic outcomes.

A large body of research from K-12 education has shown **impacts of air quality and ventilation on elementary student performance in core subject areas**.

Additional research has validated this connection in higher education settings. Studies have found strong connections between objective measures of indoor air quality, student views of air quality, and learning outcomes in university classrooms.

When air quality improves, learning and achievement increase; as air quality deteriorates, achievement falls.

Researchers have honed in on this relationship and found that key cognitive functions that are critical to the learning process are directly affected by indoor air quality. Multiple studies have confirmed that **air quality has significant impacts on an individual's ability to focus–a vital component to the learning process**.

A European study looked at the relationship between indoor air quality–as measured by levels of carbon dioxide–and performance on a test measuring one's ability to concentrate. Results showed that **higher rates of air pollution were associated with lower rates of an individual's ability to focus on material.**

Similar studies have been done in office settings and found that higher levels of particulate matter in the air and lower ventilation rates were associated with lower cognitive function including slower response times and reduced accuracy in response to simple questions.

Because of the profound impact of indoor air quality on brain function and cognitive health, public health researchers have called on decision-makers to prioritize policies and practices that **ensure individuals are in environments that are well-ventilated and have low rates of particulates and carbon dioxide**.

Routine cleaning and maintenance of facilities are critically tied to these efforts.

Routine cleaning reduces dust mites, pathogens, other allergens, and mold growth–all of which are detrimental to the quality of the air in a classroom or building. Ensuring ventilation systems are working properly and well-maintained, including cleaning filters, ducts, and vents, reduces the number of particulates in the air and promotes healthy air circulation throughout rooms and buildings.

Regularly cleaning surfaces removes dirt, bacteria, and dust that can become airborne and negatively impact overall air quality. **Colleges and universities should view efforts to implement thorough processes for routine cleaning and maintenance as critical to student learning and success.**

Student Health and Wellbeing Correlations with Facilities Conditions

"Poor facilities can absolutely get in the way of student performance. Students won't learn well in a freezing classroom with a failed heating system. They won't rest comfortably in a residence hall with broken toilets. They won't feel a warm glow of community in a student center with buckets positioned to catch rain. To achieve student success, the first charge upon facilities staff is to address the basics and the last is to do no harm. Nevertheless, many buildings on colleges and university campuses today are doing harm by failing to meet the basics."

- *"Transforming Facilities to Achieve Student Success," APPA Thought Leaders Series*

Student Health and Wellbeing Correlations with Facilities Conditions

Student mental health, wellbeing, and safety are of utmost concern for institutions of higher education as they seek to create an environment conducive to learning, growth, and happiness.

Research has shown strong correlation between campus facility condition and students' wellbeing and that **cleaning and building maintenance should be a critical part of their efforts.**

Studies have delved into cleanliness and social and individual wellbeing and have identified that clean environments promote physical, mental, and community wellbeing. **One study noted that cleaner environments foster collaborative community interactions, reduce crime, and yield a better quality of life.** These outcomes are intertwined with a positive view on campus culture.

Impact of Cleanliness on Student Health

Other studies have found a link between facility cleanliness and individual student health. In a survey of students, **78% of respondents– reported that the cleanliness of campus facilities affected their physical health.** The most specific ways included allergies, germ transmission, and presence of bugs or rodents.

Dormitories are one of the most important categories for institutions to consider in the impact of cleanliness and maintenance on student health.

A report found that **the average door knob of a women's dorm bathroom harbored over 1,500,000 colony-forming units of bacteria per square inch**. And, of the bacteria found, **more than 90% was harmful to student health and had the potential to cause infections** including meningitis, pneumonia, and strep throat. The cleaning required to disinfect these communal living spaces is often outside the supplies or capabilities of individual students.

Student Mental Health, Wellbeing, and Sleep

Research has concluded that campus aesthetics and an overall well-kempt environment fosters a sense of wellbeing in students. This is validated in a survey where, **78% of respondents reported that the cleanliness of campus facilities affected their stress levels**, with facilities in poor condition leading to more stress.

Research has also identified that environmental factors play a significant part in the quality of sleep students get. In a dorm setting, factors including ambient temperature, relative humidity, CO2 levels, and particulate matter have been identified as significant contributors to interruptions and challenges with sleep. Researchers have noted that, specific to college students, poor sleep can lead to higher rates of anxiety and depression, increased stress, and cognitive deficits.

Therefore, poor environmental conditions in dorms that disrupt sleep directly impact the physical, cognitive, and emotional wellbeing of students. These factors affect students for the duration of their time on campus, and are all the more important for faculty and other employees who spend longer spans of time within these buildings over years and even decades.

Deferred Maintenance Leads to Substantially Higher Costs & System Failures

"Presidents, trustees and senior administrators at... colleges and universities all feel the pressures: keep tuition down, be competitive academically and make sure the physical campus draws talent from a shrinking pool of traditional high school graduates and new nontraditional students. Given resource limitations, something's got to give and, for many campuses, investment in facilities is the first to get cut."

- *James A. Kadamus, New England Board of Higher Education*

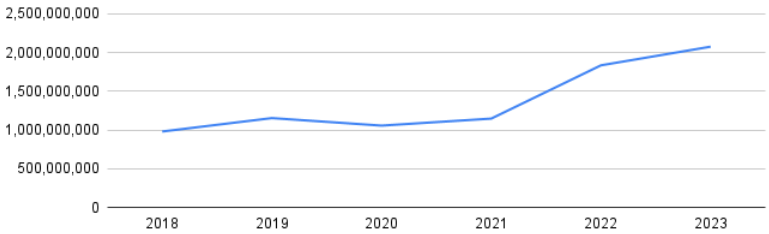
Cleanliness and Conditions Directly Impact Attendance & Dropout Rates

This description succinctly describes the overwhelming and complex situation that colleges and universities face as they look to the future. The data on the reality of facilities closely matches the warning–**many schools have been forced to delay investment in their facilities**, including crucial repairs and maintenance, over the course of many years a**nd instead fallen into the trap of what has been described as "'breakdown maintenance'**--a maintenance program in which nothing is done to a piece of equipment until it breaks down."

While putting off costly repairs in the short-term can seem like a cost-saving measure, research has repeatedly shown that **deferred maintenance significantly increases costs over time** as it "**allows damage to accumulate**, compounding an organization's problems" and **leading to much larger repairs down the line."**

Deferred Maintenance Costs Colleges Billions

The figures on the long-term negative budgetary impact of deferring maintenance of facilities equipment and infrastructure in higher education are staggering. A 2012 article in the Chronicle of Higher Education estimated that **deferred maintenance on college campuses "amounts to about $36-billion across the country, with $7-billion of that considered urgent.**" Even more alarmingly, the federal government estimated in 2011 that deferred maintenance just for community colleges was likely around $100 billion. And the situation has only gotten worse in the interim years. A 2021 report on the State University System in Florida estimated a backlog of deferred maintenance that "exceeded $1.8 billion" there alone.



Texas: HEF and Total Expenditures for Deferred or Critical Deferred Maintenance By Year

In 2024, the University of Massachusetts system reported $4.8 billion in costs that have accumulated over the past decade. Overall projections show that **between 2015 and 2020, deferred maintenance costs grew by 37% and these costs now average $120 per gross square foot.** And now colleges and universities that have upgraded their campuses to include many modern facilities face even greater challenges to maintain the cleanliness, repairs, and overall condition of their buildings. **These facilities have higher water, electrical, data, and other utility presence,** increasing both their capability for community usage but also demanding a higher level of maintenance for availability. A recent report described these layers of challenges now facing higher education facilities teams: "**most institutions [now] face the dual challenge of replacing or renovating aging buildings while maintaining newer "smart" buildings that require more frequent and complex upgrades**."

The Costs are More than Dollars

The cost of this deferred maintenance is wide and far-reaching and hits at the core mission and goals of higher education institutions.

With **improperly maintained equipment and facilities, colleges are more likely to experience system failures.** Most notably, facilities that are improperly maintained can be **a health and safety hazard for students and staff**, and the issues and related impacts often require costly and time-intensive efforts.

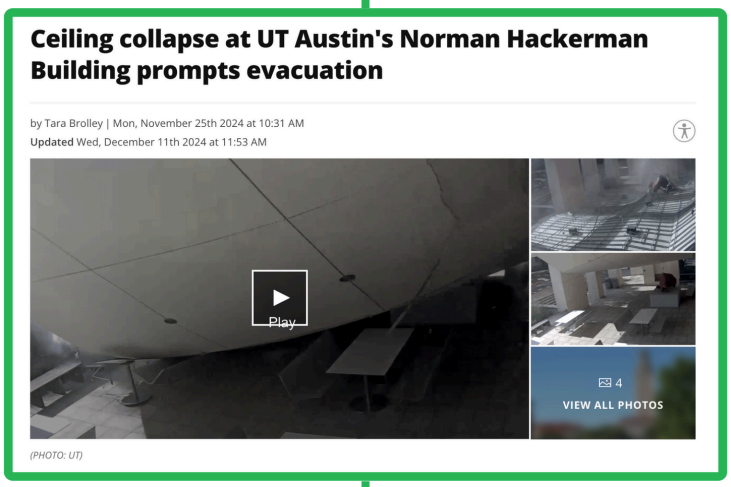
These failures can result in short-term disruptions or result in more catastrophic crises that compromise the safety and longer-term productivity of students and staff.

Studies have shown that deferred maintenance can lead to safety issues and other hazardous conditions on college and university campuses. **These include structural failures, fire hazards, air quality issues, and increased risks of injury for students, faculty, and staff.**

Headlines of infrastructure failures on college campuses have documented these risks coming to fruition:

- Ceiling collapse at UT Austin's Norman Hackerman Building prompts evacuation
- Student dead, 2 injured after column collapses at Lewis & Clark College
- Balcony Collapse at Harvard Education School Injures Two.

It is critical that colleges and universities shift their approaches to maintenance and upkeep in order to prevent more of these disasters from occurring.



The Challenge For Higher Education Leaders

The good news for higher education administrators is that the base level of the quality of their institutions' physical infrastructure is well within their control. They allocate the personnel, set aside the budget for supplies, and establish the minimal level of quality that is acceptable for the community. Unfortunately, without making well-informed decisions, the cost of having clean, well-maintained, and safe facilities can be significant and depends on square footage, acreage, and the type of facilities.

The cost of cleanliness is more dependent on the frequency of emptying trash cans and waxing floors, the proactive end-of-life replacement of window caulking and HVAC filters, and the product quality selected for installation. However, **the nuances and interdependencies of cleaning schedules, preventive maintenance, and total lifetime cost of facilities infrastructure are not domains of expertise for the vast majority of higher education administrators**. Even Chief Facilities Officers, the administrative experts charged with advising the chief executive on staffing and funding, are often not current given the rapid rate of change in technologies, materials, and other industry practices.

Finding ways to improve the efficiency, accountability, and quality of maintenance and custodial operations can significantly impact operational effectiveness, resource management, long-term sustainability, and overarching morale and engagement. There are always significant budgetary pressures on higher education institutions. Faculty salaries, student financial aid, and building new facilities are always in need of increased investment, and it can be very tempting to reduce the fixed costs of physical maintenance by eliminating staffing positions, reducing treatment frequency, or deferring maintenance. If not undertaken strategically, these actions will result in significant institutional damage: loss of reputation due to environmental discomfort, a negative visual impression being extrapolated to a lack of institutional quality, and balloon payments at times of systems failures that are much more expensive than what would have been spent on regular allocations sufficient to maintain the minimal quality and address scheduled replacements.

Modernizing Procedures Can Be a Game-Changer

Utilizing technology to optimize this work will allow colleges and universities to ensure an efficient and effective use of resources–helping them make the most out of tight budgets, rising costs, and limited maintenance staffing. In the 21st Century, integrated data systems and mobile facilities management technology are available to empower administrators and maintenance teams with tools and data to strategically plan maintenance work, track work order requests, coordinate with legacy systems, and improve cleaning quality–all with a focus on reducing costs and improving the experience of all who work and learn on college campuses.

The enhanced capabilities of monitoring, data analytics, supply chain analysis, and scheduling **provide higher education institutions with the opportunity to elevate their facilities maintenance with staffing and resource efficiencies**. Modernizing campuses is not just about constructing new buildings, it is also about updating the manner in which the portfolio of existing spaces are cleaned and maintained.

Modernizing Operations with Digital Tools and Real-Time Data

As universities look to build better learning environments for students and staff, operations leaders are consistently moving toward digital tools to help in-room education and education operations **with on average 42 distinct tools being used by students and staff over an annual school year.**

42

digital tools are used on average by students over the course of the school year.

When organizations look to their facilities, maintenance and cleaning operations, digital investment is often overlooked, however. And while students and teachers are aided in entering the digital revolution to be more efficient with their academic progress, front line operations team members are left with outdated methods.

While facing declining operational budgets along with larger deferred maintenance deficits, Higher Education leaders are beginning to invest in technologies and tools to enable more efficiency across teams and functions.

Digital innovation is being seen in many areas of operations for school districts. Mobile apps are helping field staff be more efficient while making it easier to capture accurate data on school activities.

Maintenance & Work Orders

Computerized Maintenance Management Systems (CMMS) have been a foundational tool for school operations leaders for awhile but newer technologies have arisen to make it easier to both submit requests and resolve work orders. Mobile applications are becoming crucial to improve performance, enhance productivity and driving return on investment.

Cleaning Operations

Custodial services is one of the most identifiable and impactful of school services provided by operations teams. Mobile technologies are being used by front line custodians to validate daily cleanings on their routes. This is tied to real-time analytics to understand cleaning performance across each school in the district on a daily basis.

Indoor Location as a Data Necessity

Facilities and cleaning operations is all predicated on ensuring teams cover every area of the university. As such, it's integral that the systems used to execute on and measure daily strategies uses pinpoint location in its data model.

Innovations in using QR codes to hardcode exact locations to activities are becoming popular in operations technologies helping universities provide transparency in the work being done every day.

References

APPA, “Study Shows School Cleanliness Affects Learning.” APPA, 2008. https://www.cft.org/sites/main/files/file-attachments/appaissacleaningaffectonlearningpr_000.pdf?1548805779.

APPA, APPA Thought Leader Series: Transforming Facilities to Achieve Student Success, APPA, 2017, https://www1.appa.org/FacilitiesManager/article.cfm?ItemNumber=4184&parentid=2725

Baldry, David, Keith Alexander, and Yusof Hamid. “The Cause and Effects of Deferred Maintenance on Higher Education Buildings,” January 2010. https://www.researchgate.net/publication/292963515_The_cause_and_effects_of_deferred_maintenance_on_higher_education_buildings.

Beacham, Sara C., Aubrey Newland, and Melissa Mache. “Effects of a Sleep Education Intervention on Sleep and Anxiety in Female Student-Athletes.” Women in Sport and Physical Activity Journal 33, no. 1 (January 1, 2025). https://doi.org/10.1123/wspaj.2024-0084.

Bilski, Rebecca, "School Mental Health Partnerships: A Case Study” (2025). Theses and Dissertations. 866. https://scholar.stjohns.edu/theses_dissertations/866

Budiawan, Wiwik, Heru Prastawa, Gusti Fattahilah Merdeka, and Shania Mustika Ari. “Environmental Influences on Sleep Quality in University Dormitories.” IOP Conference Series: Earth and Environmental Science 1414, no. 1 (December 1, 2024): 012012. https://doi.org/10.1088/1755-1315/1414/1/012012.

Campbell, Jeffrey L., and Alan S. Bigger. "Cleanliness & Learning in Higher Education." Facilities Manager 24, no. 4 (July-August 2008): 28–36. https://files.eric.ed.gov/fulltext/EJ938802.pdf.

Carlson, Scott, "How the Campus Crumbles: Colleges Face Challenges from Deferred Maintenance," The Chronicle of Higher Education, May 20, 2012.

Cedeño Laurent, Jose Guillermo, Piers MacNaughton, Emily Jones, Anna S Young, Maya Bliss, Skye Flanigan, Jose Vallarino, Ling Jyh Chen, Xiaodong Cao, and Joseph G Allen. “Associations Between Acute Exposures to PM2.5 and Carbon Dioxide Indoors and Cognitive Function in Office Workers: A Multicountry Longitudinal Prospective Observational Study.” Environmental Research Letters 16, no. 9 (September 1, 2021): 094047. https://doi.org/10.1088/1748-9326/ac1bd8.

Cha, Seung Hyun, and Tae Wan Kim. “What Matters for Students’ Use of Physical Library Space?” The Journal of Academic Librarianship 41, no. 3 (May 2015): 274–79. https://doi.org/10.1016/j.acalib.2015.03.014.

Choi, SeonMi, Denise A. Guerin, Hye-Young Kim, Jonee Kulman Brigham, & Theresa Bauer. "Indoor Environmental Quality of Classrooms and Student Outcomes: A Path Analysis Approach." Journal of Learning Spaces [Online], 2.2 (2013): n. pag. Web. 10 Mar. 2025

CollegeStats.org. “Bacteria on Campus: Examining Men’s and Women’s Dorm Rooms.” CollegeStats.org, June 19, 2017. https://collegestats.org/explore/bacteria-on-campus/.

Ezarik, Melissa. “Survey: Campus Facilities’ Impact on Student Success.” Inside Higher Ed. Accessed February 28, 2025. https://www.insidehighered.com/news/2022/11/22/survey-campus-facilities-impact-student-success.

Florida Board of Governors, The Issue of “Deferred Maintenance” within the State University System: How Do We Define It? How Do We Address It? How Do We Avoid It Going Forward? December 15, 2021 (Revised January 4, 2022). Accessed March 10, 2025.

References

AGordian, “2023 state of facilities in Higher Education.” Accessed February 28, 2025. https://www.gordian.com/uploads/2023/03/2023-State-of-Facilities-Report.20230321205652466.pdf.

Grupp, Amanda L. “Architecture, Aesthetics, and Education.” Creating Knowledge 2 (2009).

Heinrich, Carolyn J., Mason Shero, and Carrie E. Fry. “Efficacy of United States’ Federally-Funded Interventions in Increasing School Capacities to Improve Student Mental Health and Education Outcomes in Tennessee.” SSM - Mental Health, March 2025, 100421. https://doi.org/10.1016/j.ssmmh.2025.100421.

“How Does Facility Quality Impact College Student Enrollment and Retention?” The Budd Group, October 24, 2024. https://www.buddgroup.com/how-does-facility-quality-impact-college-student-enrollment-and-retention.

“Impacts of Indoor Air Quality on Cognitive Function.” Harvard T. H. Chan School of Public Health, September 9, 2021. https://www.hsph.harvard.edu/healthybuildings/2021/09/09/impacts-of-indoor-air-quality-on-cognitive-function/.

Kärnä, Sami, and Päivi Julin. “A Framework for Measuring Student and Staff Satisfaction with University Campus Facilities.” Quality Assurance in Education 23, no. 1 (February 2, 2015): 47–66. https://doi.org/10.1108/qae-10-2013-0041.

Lee, M.C., K.W. Mui, L.T. Wong, W.Y. Chan, E.W.M. Lee, and C.T. Cheung. “Student Learning Performance and Indoor Environmental Quality (IEQ) in Air-Conditioned University Teaching Rooms.” Building and Environment 49 (March 2012): 238–44. https://doi.org/10.1016/j.buildenv.2011.10.001.

McDonald, Lucinda Sue. The Impact of Campus Facilities on the Recruitment of Students in Higher Education, 2019. https://digitalcommons.wku.edu/cgi/viewcontent.cgi?article=1169&context=diss.

Myhrvold, A. N., E. Olsen, and O. Lauridsen. Indoor Environment in Schools - Pupils Health and Performance in Regard to CO2 Concentrations, 1996.

NCES, "Undergraduate Enrollment," Condition of Education, National Center for Education Statistics, last updated May 2023, https://nces.ed.gov/programs/coe/indicator/cha/undergrad-enrollment.

Nguyen, Hung Thanh, Lap Quoc Trinh, and Tho Doan Vo. “Examining International Student Satisfaction: Insights from a Medical English-Medium Instruction Program in Vietnam.” Educational Process International Journal 14, no. 1 (2025). https://doi.org/10.22521/edupij.2025.14.48.

Norton, Tim. “The Influence of Campus Facilities on the Satisfaction and Retention of Students in a Higher Education Setting.” The Repository at St. Cloud State. Accessed February 28, 2025. https://repository.stcloudstate.edu/hied_etds/70/.

Reeves, Peter, Sophie Mason, and Luke Sanders. “A National Study of Capital Infrastructure at Colleges and Schools of Agriculture: An Update.” Washington, D.C.: Association of Public and Land-grant Universities, March 2021.

Schneider, Mark. Do School Facilities Affect Academic Outcomes?, November 2002. https://www.scribd.com/document/31561967/Schneider-Do-School-Facilities-Affect-Academic-Outcomes-2002.

References

Shaughnessy, R. J., U. Haverinen-Shaughnessy, A. Nevalainen, and D. Moschandreas. “A Preliminary Study on the Association between Ventilation Rates in Classrooms and Student Performance.” Indoor Air 16, no. 6 (December 2006): 465–68. https://doi.org/10.1111/j.1600-0668.2006.00440.x.

“Student Success in College: Creating Conditions That Matter.” Choice Reviews Online 43, no. 03 (November 1, 2005). https://doi.org/10.5860/choice.43-1725.

Texas Higher Education Coordinating Board. (2024). Higher Education Fund Recommendations for Fiscal Years 2026-35. Austin, TX.

University of Massachusetts System, FY24 – FY28 Capital Plan. Boston, MA: University of Massachusetts, September 20, 2023.

Whitt, Elizabeth J., John H. Schuh, Jillian Kinzie, and George D. Kuh. Student success in college: Creating conditions that matter. San Francisco, Calif: Jossey-Bass, 2005.