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Windows and Classrooms: A Study of Student Performance and the Indoor Environment

California Energy Commission, October 2003, 500-03-082-A-7

This study investigates whether daylight and other aspects of the indoor environment in elementary school student classrooms have an effect on student learning, as measured by their improvement on standardized math and reading tests over an academic year. The study uses regression analysis to compare the performance of over 8,000, 3rd through 6th grade, students in 450 classrooms in the Fresno Unified School District, located in California's Central Valley. Statistical models were used to examine the relationship between elementary students' test improvement and the presence of daylight in their classrooms, while controlling for traditional education explanatory variables, such as student and teacher demographic characteristics. Numerous other physical attributes of the classroom were also investigated as potential influences, including ventilation, indoor air quality, thermal comfort, acoustics, electric lighting, quality of view out of windows, and the type of classroom, such as open or traditional plan, or portable classroom. The study also utilized on-site observations of classrooms and surveys of teachers to provide additional insight into comfort conditions. The study did not replicate the findings of a previous study when using the same form of the statistical models. However, this study did find that various window characteristics of classrooms were had as much explanatory power in explaining variation in student performance as more traditional educational metrics such as teacher characteristics, number of computers, or attendance rates. The study provides a range of likely effect sizes for environmental variables that other researchers can use to refine the needs of future studies.

Daylighting in Schools: Reanalysis Report

California Energy Commission, October 2003, P500-03-082-A-3

The "Daylighting in Schools: Reanalysis Report" is part of the Productivity and Interior Environments research project, one of six research elements within the Integrated Energy Systems: Productivity and Building Science Program. The Program was funded by the California Energy Commission's Public Interest Energy Research (PIER) Program. This study expands and validates previous research by Hescong Mahone Group that found a statistical correlation between the amount of daylight in elementary school classrooms and student performance. The researchers reanalyzed student performance data from two school districts to answer questions raised by the previous study. The reanalysis found that:

- Elementary school students in classrooms with the most daylight showed a 21% improvement in learning rates compared to students in classrooms with the least daylight.
- There was no teacher assignment bias that might have skewed the original results; more experienced or more educated teachers were not significantly more likely to be assigned to classrooms with more daylighting.
- The daylighting effect does not vary by grade.
- Physical classroom characteristics (daylighting, operable windows, air conditioning, portable classrooms) do not have an effect on student absenteeism. This seems to contradict claims that have been made about the health effects of daylight or other environmental conditions, as reflected in absenteeism rates of building occupants.

These results, which are consistent with the original findings, affirm that daylight has a positive and highly significant association with improved student performance. These findings may have important implications for the design of schools and other buildings.

The Impact of Day Lighting in Classrooms on Students' Performance

Ammar Saddik Dahlan, Mahmoud Ahmad Eissa - *International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-4 Issue-6, January 2015*

The study examines daylight and other features of indoor environment of classrooms on students' learning over an academic year at selected faculties at King Abdul-Aziz University campus at Jeddah, Saudi Arabia. Correlation analysis is used to compare the performance of 400 students in 20 classrooms at the selected faculties. The classrooms were on different floors of educational buildings. A statistical model was used to investigate the link between Daylight in classrooms and students' performance in their classrooms, despite the fact of existence of traditional descriptive learning

variables. Other elements including, thermal comfort, Indoor air quality, acoustics and artificial light are examined to indicate any possible effect to students' performance. Further investigation was made which include interviews with teaching staff to examine the effect on classroom daylight on students' academic performance.

The Impact of Indoor Lighting on Students' Learning Performance in Learning Environments: A knowledge internalization perspective

Sanaz Ahmadpoor Samani, PhD Student University Technology Malaysia (UTM), Soodeh Ahmadpoor Samani Lecturer of Art University of Applied Science - International Journal of Business and Social Science Vol. 3 No. 24 [Special Issue – December 2012

Many elements have affected into environments, and the environments have directly affected people. Well designed environments make people happy and energize and vice versa. These elements start with building structure and shape, and complete with color, light, outside viewing and furnish. Sometimes, the influence of light in the environment is much more than other elements. Understanding the relationship between light and the environment can help designers or architects to improve interior designs for better performance (Oneworkpalce, 1999).

In this study, the researchers have focused on the influence of light (indoor lighting) on students learning performance. Also this study observes this process from the knowledge internalization perspective which refers to SECI model of knowledge conversion that came from Professor Ikujiro Nonaka and his colleague (Gourlay, 2003). The researchers mention the SECI model in this study because it is important to manage knowledge for a variety of reasons, then having a good model to support this process also is equally significant. In 1998 Nonaka and Konno introduced the "Japanese theory of Ba", which related to the physical, relational and spiritual factors of „place, or possibly „context. The SECI model (figure 1) shows the process of conversion, creation and transition of information and knowledge from tacit to explicit and explicit to tacit. In fact, the environment and all elements are exist in environment have very critical role and direct impact to these transition and creation of knowledge (Rice & Rice, 2005).

Effect of daylighting on student health and performance

Seyedehzahra Mirrahimi, Nik Lukman Nik Ibrahim, M.Surat - Department of Architecture, Faculty of Engineering and Built Environment, National University of Malaysia, March 2013

Daylighting is an efficient method for providing better learning conditions and health in schools. Poor daylighting causes discomfort, which reduces learning and it is detrimental to the physical and mental health of students. This study focuses on the effects of daylighting on the physical health, psychological well-being, and performance of students in schools. The paper aims to provide architects, building designers, and researchers with additional information and a better understanding of the effects of daylight on student health and performance.

Lighting boosts the active learning environment

Lighting World, Henri Juslén, January 2015

A slump in student productivity and overall concentration levels can be attributed to many factors, one of which being poor lighting control. Here, PhD Henri Juslén, Product Development Director from Helvar looks at the impact that human centric lighting and tunable white technology can have on the mood of students and staff when it comes to promoting a comfortable learning environment.

Impacts of Daylighting on Preschool Students' Social and Cognitive Skills

Safak Yacan, University of Nebraska-Lincoln, safakdincer@gmail.com, summer 8-2014

The built environment has a remarkable role in people's lives. A knowledge, which is formulated from with multiple life practices, shows that the human has a unique and complex mind. According to results of environmental psychologists' research, people are influenced by aspects of their surroundings. In this context, green structures have made their way into the design and architecture professions, and also have become a powerful target of study and practice. Many reasons make the concept of green building popular and the environmental benefits may be the most frequent reason for ecobuildings. Interior design includes many interdependent elements, which include space, form, structure, lighting, texture and color.

In this study, the one interior design element, lighting, is examined at depth within the context of preschool design. Daylight is the primary light source which, aside from being indispensable, has the potential to create cozy and comfortable interior environments. Daylighting is a free natural resource, which allows buildings to develop physical and psychological reactions. Equally important natural light is a renewable resource. Adequate daylighting has been demonstrated to make environments healthier (Zaharim, Azami and Kamaruzzaman, Sopian. Computational Methods in Science & Engineering. WSEAS Press: 2013). Various research projects have already displayed that student performance increases when their classrooms enjoy natural light (Demir, Ayse. "Impact of Daylighting on Student and Teacher Performance." Journal of Educational Instructional Studies in the World 3, no.1 (2013): 1-7). Skylight generally provides a simple illustration function that overhead horizontal openings allow light to enter but they do not allow inhabitants to view the exterior landscape, whereas windows have a far more complex effect on people. It has been postulated that by including educational facilities with skylights rather than natural lighting from windows, we could better separate the effects of

daylight. Skylight usually gives a simple illuminating function, whereas windows may have a far a complex effect on people. Furthermore, in what ways do students react and how do habits develop in these planned spaces? Daylighting will also vary from one school building to another, depending on building orientation, site, climate and latitude, so that cookie-cutter building design will rarely provide ideal lighting. In the Northern Hemisphere, this can turn south facing walls into a great source of indirect light. Relating to the orientation of the rooms the “windows direction” is determined and resulting in effects of direct sunlight and daylight. The design professionals must provide extraordinary design leadership through the use of natural daylighting and daylight modeling. The use of research for health and productivity benefits of natural daylight and daylighting modeling must be considered.

A Study on Influences of Lighting on Resource Usage in an Institution Library

IJRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321-7308, G. Thangaraj1, S. Suresh Balaji2. August 2014

Lighting can be made possible by natural and artificial means, using the daylight efficiently is recommended by OSHAS to perform the task easily, effectively and also economically. Artificial lighting has to be made possible whenever the nature lighting is not sufficient for using the library, more often artificial lighting is provided after evening and also during moody days in raining seasons.