Educational Administration: Theory and Practice
2024, 30(5), 12480-12485
ISSN: 2148-2403
https://kuey.net/

Research Article

"Lighting The Way To Better Learning: Assessing And Addressing Artificial Light Concerns In Classrooms"

Dileep Geddam[1*], Viswanadha Kumar Giduturi[2], Vijaya Ratna Mugada[3]

[1*]Ph.D. Scholar, [2]Professor & Research Guide, [3]Assistant Professor
Dept. of Architecture, AU College of Engineering (A), Andhra University, Visakhapatnam- 530003, AP, India

***Corresponding Author**: Dileep Geddam,
*Ph.D. Scholar, Dept. of Architecture, College of Engineering (A), Andhra University, Visakhapatnam- 530003, AP, India
Email: dileep9geddam@gmail.com , Orcid Id #0000-0001-5662-7409, Scopus Id #57200383895

Citation: Dileep Geedam , et al (2024), "Lighting The Way To Better Learning: Assessing And Addressing Artificial Light Concerns In Classrooms" *Educational Administration: Theory and Practice, 30(5), 12480-12485*
Doi: 10.53555/kuey.v30i5.4040

ARTICLE INFO

ABSTRACT

This study examines the effect of artificial lighting on college student's health and academic performance, a pertinent issue as educational settings increasingly utilize artificial environments. The research was conducted in Visakhapatnam, employing a cross-sectional survey methodology involving 500 students. The preliminary data collection tool was a structured questionnaire, which gathered information on the student's dependency on artificial lighting and the frequency of associated health symptoms. The methodology included descriptive statistics to summarize the data and chi-square tests to evaluate the relationships between artificial lighting dependency and health symptoms. The results indicate a significant correlation between high dependency on artificial lighting and increased reports of eye discomfort, headaches, and drowsiness. These symptoms affect students during class hours and extend into night hours, impacting sleep quality and overall health. The study concludes that excessive reliance on artificial lighting in educational settings may detrimentally influence student health and learning outcomes. It underscores the importance of reassessing and redesigning lighting systems in educational institutions to integrate more natural light, aiming to enhance student well-being and academic performance. This research contributes essential insights into optimizing indoor environmental quality in educational settings, providing a basis for future research and policy-making.

Keywords: Artificial Lighting, Academic Performance, Classroom Environment, Indoor Environment Quality (IEQ), Student Health, Headaches, Well-being.

Introduction

"Architecture is not just about buildings," Brancusi declared, "it is sculpture we inhabit" (Brezianu, 1965). " Similarly, Winston Churchill observed the profound connection: "We shape our structures, and thereafter, our structures shape us" (SF, 2008). This interplay between architecture and its occupants underpins the vital role of the built environment, not just in providing shelter or workspace but as a determinant of health, behaviour, and social interaction (Richa Jagatramka, 2020).

The Built Environment directly impacts our world and affects all human beings' live.

Our built environment comprises all the Physical Spaces created by man where we live, recreate, and work (Clements-Croome, 2004). We Homo sapiens spent much of our time outdoors as hunters and gatherers, stayed in temporary buildings, and wandered wherever the best food and opportunities occurred (Marlowe, 2005). Only relatively recently, industrialization allowed us to live in permanent homes and spend less time outside (Dowd, 1981). The National Human Activity Pattern Survey (NHAPS) studies reveal that people, on average, spend approximately 79% - 90% of their time indoors in enclosed buildings and enclosed Vehicles in a day. These proportions are relatively constant across the various regions of the globe (Joseph V. Behar).

Although our modern lifestyles undoubtedly have enormous benefits, we should also be aware that the large amount of time we spend indoors may negatively affect our health and well-being. ASHRAE 2010 guidelines

have indicated that a range of comfort and health-related effects are linked to building design (Mohammed Arif, 2016). Human well-being and comfort are major topics for research into indoor environmental quality (IEQ). Internal environment quality (IEQ), which includes aspects such as heat, light, sound, and air quality, is a crucial IEQ factor for the overall satisfaction of the occupant. If the IEQ factors are Poor, the performance and productivity of the occupant's well-being, comfort, and satisfaction are Compromised mentally and physically (Peter Barrett Fay Davies, 2015).

Significance of the study

India is called a young country as the age group of 15-34 increased from 353 million in 2001 to 430 million in 2011. According to current estimates, the world's young people will number 464 million by 2021, which is approximately around 33% of the whole population in India (MOSPI, 2022).
In this case, India has an excellent opportunity for the education sector, and the numeral colleges and universities in India reached 39,931 and 993, respectively, in FY19. India had 37.4 million students enrolled in higher education in FY19 (IBEF, 2020). Classroom infrastructure and Indoor Environment Quality (IEQ) are very important for Schools and Colleges. Lighting is one of the essential elements of the classroom and directly affects student learning and performance. Having the correct form of light is fundamental to the student's ability to concentrate. In terms of lighting, daylight has a special place. Many studies have shown that access to natural light and fresh air can increase health, comfort, and productivity (Gregg, 2008). Due to insufficient natural lighting, the student's circadian rhythms will be affected. It will lead to health problems like eyestrain, severe musculoskeletal injuries, decreased attention span, increased body temperature, and low student and teacher performance (John, 2005). A conducive and comfortable classroom environment motivates the students to perform better and encourages the Teaching- learning process. It is crucial to understand the impact of the classroom-built environment on students' health exposure and concentration performance as the students spend most of their time indoors in the classroom (Oruikor, 2023).

2.1 Lighting inside a Classroom: How Critical Is It?

A good classroom lighting plan will use any available natural light and supplement it with artificial light as necessary. Pupils, instructors, and administrators can all benefit from using natural light in their classrooms (Innova, 2014). So many studies have revealed that natural light in classrooms has numerous benefits, the most obvious of which is energy savings; nevertheless, natural light also has positive effects on students' overall health and well-being and significantly impacts academic performance. One such study conducted by Sorbonne University included 2,387 students from 13 European countries. It concluded that more expansive windows admitting more daylight could boost academic achievement by up to 15% (Velux, 2018).

2.2 Lighting and its impacts on students' concentration

The impact of lighting on students' concentration is a crucial aspect of classroom design and educational performance. Adequate lighting enhances visibility and influences mood, alertness, and overall cognitive function (Sanaz Ahmadpoor Samani, 2012).
Visibility and Reading Performance: Good lighting facilitates clear visibility of textbooks, whiteboards, and other educational materials, reducing eye strain and fatigue (Pankaj Dhayal, 2023). Research indicates that appropriate lighting levels significantly improve reading comprehension and speed (Male Shiva Ram, 2018). Subpar lighting, on the other hand, can lead to squinting, headaches, and difficulty focusing, all hamper concentration and learning (Pratima Singh., 2020).
Circadian Rhythms and Alertness: Natural light is vital in restraining our circadian rhythms, the internal biological clock that controls sleep-wake cycles. Exposure to natural daylight helps synchronize these rhythms, promoting feelings of wakefulness and alertness during the day. Conversely, inadequate lighting, particularly in classrooms with limited access to natural light, can disrupt circadian rhythms, leading to drowsiness and reduced attentiveness (Christine Blume., 2019).
Mood and Emotional Well-being: Lighting influences our mood and emotional state, affecting concentration and academic performance. Bright, well-lit environments are associated with increased positivity, energy, and motivation, whereas dim or harsh lighting can evoke gloominess and fatigue (Sleegers, 2013). By creating a positive learning atmosphere through appropriate lighting design, educators can help students maintain focus and engagement throughout the school day (Lekan Kehinde, 2021).

2.3 Task Performance and Productivity

Different learning activities require varying levels and qualities of light. For instance, tasks that involve detailed visual work, such as math or science exercises, benefit from higher light levels to enhance accuracy and speed. Conversely, group discussions or creative brainstorming may benefit from softer, more diffused lighting to foster a relaxed and collaborative atmosphere. Educators can optimize students' concentration and productivity by adjusting lighting levels and characteristics to suit specific learning tasks (Falloon, 2019).

2.4 Study area
The study targeted students from colleges located in Visakhapatnam. This demographic represents a diverse young adult population engaged in higher education, who typically spend significant periods indoors, making them an ideal cohort for assessing the impacts of classroom environmental factors like lighting.

Methodology

This investigation used a cross-sectional survey methodology to investigate the relationship between classroom artificial lighting dependency and the frequency of various student symptoms. A structured questionnaire was aided to a sample of 500 students selected through random sampling.

The questionnaire gathered data on two key variables:
- Dependency on Artificial Lighting: Participants were asked to indicate whether they considered themselves dependent on artificial lighting in their classrooms ('Yes' or 'No').
- Frequency of Symptoms: Students reported the frequency with which they experienced a range of symptoms, such as Drowsiness, Eye Discomfort, Headaches, Sleep Difficulty, Fatigue, and Difficulty Concentrating. Response options were 'Occasionally', 'Frequently', and 'Rarely'.

3.1 Data Analysis
Descriptive statistics were computed to illustrate the sample demographics and the overall distribution of responses. The primary analysis involved the use of a Chi-square test of independence. This test assessed the relationship between dependency on artificial lighting and the frequency of each reported symptom. Participants were categorized according to their dependency status ('Yes'/'No') and the frequency with which they experienced each symptom ('Occasionally', 'Frequently', 'Rarely). The Chi-square test determined if statistically significant associations existed between these variables.

Results and Findings

The analysis of the survey on the effects of artificial lighting in classrooms, conducted among 500 students, highlights several crucial insights regarding their dependency on artificial lighting and the associated symptoms they experience during class hours and at night. The detailed results are presented in the accompanying pie charts. A significant proportion of students reported a high dependency on artificial lighting during class hours, which correlates with increased symptoms such as eye strain, headaches, and fatigue. Notably, these symptoms are prevalent during class hours and persist into the night, affecting students' quality of sleep and overall well-being. The pie charts provide a visual breakdown of these findings, illustrating the percentages of students affected by various symptoms and their dependency levels on artificial lighting.
This survey's findings indicate that students dependent on artificial lighting in classrooms report higher frequencies of eye discomfort, headaches, drowsiness, and other symptoms during class hours. These results support the hypothesis that artificial lighting may be a contributing factor to physical and psychological discomfort in educational environments.
This study conducted a chi-square test of independence to reckon the relationship between two categorical variables: dependency on artificial lighting and the frequency of symptoms among students. This statistical test was selected because it is particularly effective in determining whether there is a significant association between categorical variables, making it suitable for exploring how different conditions affect health outcomes in educational settings.
Tables and figures for the frequencies of various symptoms caused by dependency on artificial lighting have been created (See tables and Figures).

4.1 Results of Chi-square
Eye Discomfort Chi-square (χ^2): 36.6845, $p < 0.00001$, $df = 2$
Headaches Chi-square (χ^2): 37.9666, $p < 0.00001$, $df = 2$
Drowsiness Chi-square (χ^2): 13.5959, $p = 0.0011$, $df = 2$
Symptoms During Class Hours Chi-square (χ^2): 38.4919, $p < 0.00001$, $df = 2$

For each symptom, the p-value was significantly below the 0.05 threshold, indicating a statistically significant association with artificial lighting dependency.
The statistical evidence suggests a notable correlation between classroom artificial lighting and the prevalence of specific symptoms among students. These findings prompt a closer examination of lighting conditions in educational environments.

Figure 1: Pie charts illustrating the percentages of students affected by various symptoms

Table 1: Frequencies of Eye Discomfort by Dependency on Artificial Lighting

Dependency on Artificial Lighting in Classrooms	*Occasionally*	*Frequently*	*Rarely*
Yes	265	103	88
No	5	18	21

Table 2: Frequencies of Headaches by Dependency on Artificial Lighting

Dependency on Artificial Lighting in Classrooms	*Occasionally*	*Frequently*	*Rarely*
Yes	254	117	85
No	6	14	24

Table 3: Frequencies of Drowsiness by Dependency on Artificial Lighting

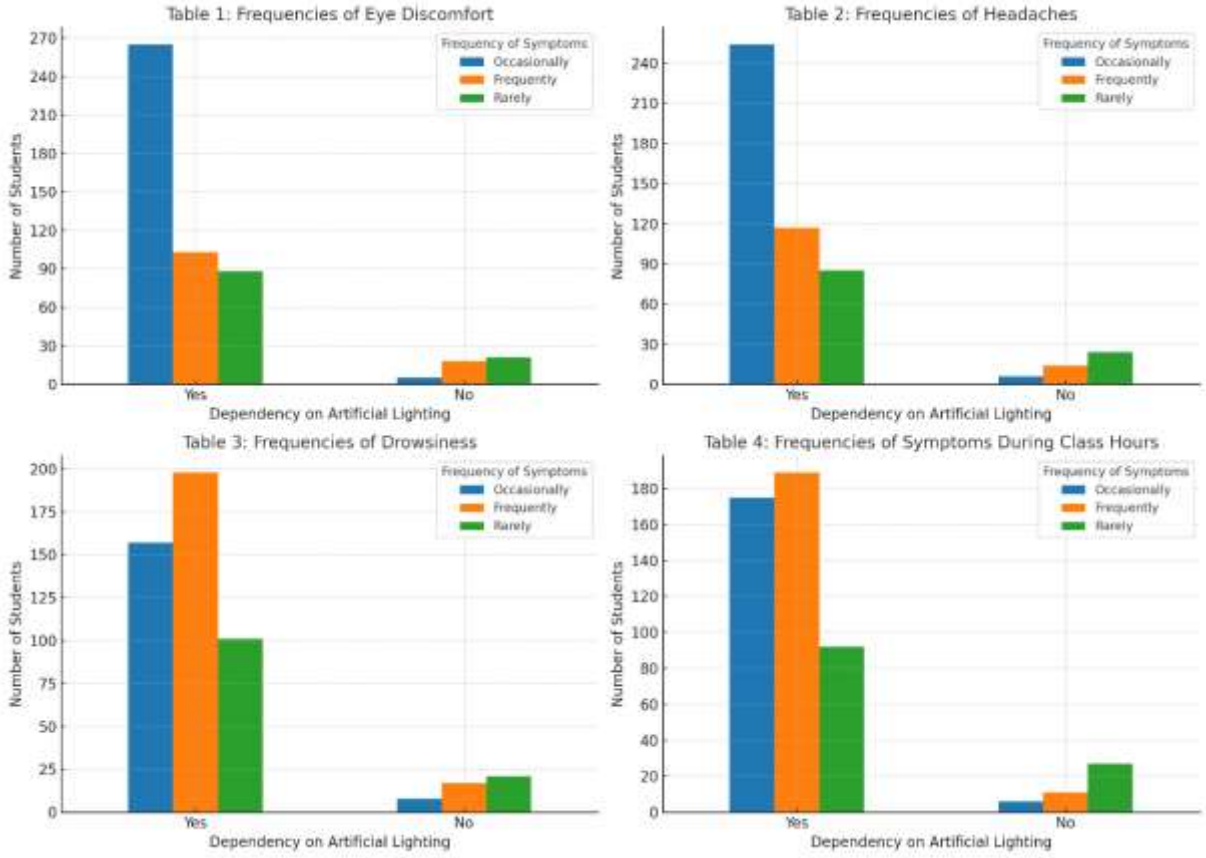
Dependency on Artificial Lighting in Classrooms	*Occasionally*	*Frequently*	*Rarely*
Yes	157	198	101
No	8	17	21

Table 4: Frequencies of Symptoms (Fatigue, Difficulty Concentrating, Moodiness or Irritability

Dependency on Artificial Lighting in Classrooms	*Occasionally*	*Frequently*	*Rarely*
Yes	189	175	92
No	6	11	27

The bar charts for these tables have been compiled into one image to provide a clear visual representation of the data (See Figure 2).

Figure 2: Bar charts showing students' dependency on artificial lighting and frequency of symptoms



Conclusion

This study's findings confirm that artificial classroom lighting significantly affects students' health and academic performance. A high dependency on artificial lighting was linked to increased reports of eye discomfort, headaches, and drowsiness among the students surveyed. These symptoms negatively impact students' concentration and learning capabilities, suggesting a critical need for educational institutions to reassess and redesign lighting systems to reduce dependency on artificial light. While this research focused primarily on artificial lighting, it is crucial to acknowledge that other factors also play significant roles in shaping the indoor environmental quality of classrooms. These include the specific type of lighting used, the lux levels maintained, the adequacy of cross ventilation, and the levels of CO_2, all of which can substantially affect students' health and concentration. Future research should investigate these variables in depth to offer a more comprehensive understanding of the interdependencies within classroom environments. This broader perspective will provide actionable insights for policymakers and educational administrators in Visakhapatnam and similar regions to optimize classroom conditions for better health outcomes and academic success.

References

1. Brezianu, B. &. (1965). The Beginnings of Brancusi. *Art Journal, 25*(1), 15-25. doi:doi.org/10.2307/774863
2. Christine Blume., C. G. (2019). Effects of light on human circadian rhythms, sleep and mood. *Somnologie, 23*, 147-156. doi:https://doi.org/10.1007/s11818-019-00215-x
3. Clements-Croome, D. J. (2004). Building environment, architecture and people. In *Intelligent buildings: Design, management and operation* (pp. 53-100). ICE Publishing. doi:10.1680/ib.32668.0003
4. Dowd, J. J. (1981). Industrialization and the Decline of the Aged. *Sociological Focus, 14*(4), 255-269. doi:10.1080/00380237.1981.10570400
5. Falloon, G. (2019). Using simulations to teach young students science concepts: An Experiential Learning theoretical analysis. *Computers & Education, 135*, 138-159. doi:https://doi.org/10.1016/j.compedu.2019.03.001
6. Gregg, D. A. (2008). *Whole building design guide - windows and glazing. Retrieved.* Retrieved from http://www.wbdg.org/resources/windows.php.
7. IBEF. (2020, Dec 23). *Education & Training Industry in India*. Retrieved from IBEF: https://www.ibef.org/industry/education-sector-india.aspx#:~:text=India%20had%2037.4%20million%20students,with%20around%209.5%20million%20users.
8. Innova. (2014, December 05). *How Important is Lighting in a Classroom*. Retrieved from innovadesigngroup: https://www.innovadesigngroup.co.uk/news/how-important-is-lighting-in-a-classroom/
9. John, M. &. (2005). *Illuminating the Classroom Environment*. School Planning & Management.
10. Joseph V. Behar, S. C. (n.d.). *The National Human Activity Pattern Survey (NHAPS)*. National Exposure Research Laboratory , U. S. Environmental Protection Agency.
11. Lekan Kehinde, M. A. (2021). Impact of lighting on Children's Learning Environment: A Literature Review. *SUSTAINABLE CITY 2021*, (pp. 371-380). doi:10.2495/SC210311
12. Male Shiva Ram, M. B. (2018). Effect of Different Illumination Sources on Reading and Visual Performance. *Journal of Ophthalmic and Vision Research, 13*(1), 44-49.
13. Marlowe, F. W. (2005). Hunter-Gatherers and Human Evolution. *Evolutionary Anthropology Issues News and Reviews, 14*(2), 54-67. doi:10.1002/evan.20046
14. Mohammed Arif, M. K. (2016). Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature. *International Journal of Sustainable Built Environment*, 1-11.
15. MOSPI. (2022). *Youth In India 2022 - 4th Issue*. National Statistical Office.
16. Oruikor, G. E. (2023). The impact of classroom design on student learning: a case study of Cameron Schools. *Journal of Global Issues and Interdisciplinary Studies, 1*(1), 21-40.
17. Pankaj Dhayal, D. B. (2023). Indoor Visual Comfort: A Review of Factors and Assessments. *International Society for the Study of Vernacular Settlements, 10*(11), 38-59. doi:10.61275/ISVSej-2023-10-11-03
18. Peter Barrett Fay Davies, Y. Z. (2015). The impact of classroom design on pupils' learning: Final results. *Building and Environment*, 118-113.
19. Pratima Singh., R. A. (2020). Impact of Lighting on Performance of Students in Delhi Schools. *Indoor Environmental Quality*, 95-108. doi:10.1007/978-981-15-1334-3_11
20. Richa Jagatramka, A. K. (2020). Sustainability Indicators for Vernacular Architecture in India. *Journal of the International Society for the Study of Vernacular Settlements, 7*(4), 53-63.
21. Sanaz Ahmadpoor Samani, S. A. (2012). The Impact of Indoor Lighting on Students' Learning Performance in Learning Environments: A knowledge internalization perspective. *International Journal of Business and Social Science, 3*(24), 127-136.
22. SF, G. (2008). Buildings and Organizations: The Shaping and the Shaped. *HERD: Health Environments Research & Design Journal, 1*(4), 20-31. doi:10.1177/193758670800100403
23. Shivakumar, G. T. (2013). India is set to become the youngest country by 2020. NEW DELHI.
24. Sleegers, P. M. (2013). Lighting affects students' concentration positively: Findings from three Dutch studies. *Lighting Research and Technology, 45*(2), 159-175. doi:10.1177/1477153512446099
25. Velux. (2018, October 30). *Why is natural light so important in school design?* Retrieved from https://vms.velux.com/commercialblog/why-is-natural-light-so-important-in-school-design