Indian Journal of Information Sources and Services
ISSN: 2231-6094 (P) Vol.16, No.1, 2026, pp.251-259

DOI: https://doi.org/10.51983/ijiss-2026.16.1.26

Evaluation of Students' Satisfaction with Natural Lighting in Classrooms: A Questionnaire

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(Received 30 October 2025; Revised 26 November 2025, Accepted 10 December 2025; Available online 05 January 2026)

Abstract - **Recently, substantial attention has been directed to indoor environmental aspects inside buildings due to people's needs to enhance interior comfort, human wellbeing, and health conditions as a vital consequence of the coronavirus pandemic. Therefore, this study used a Post Occupancy Evaluation (POE) as an effective tool to inspect the students' satisfaction level within classrooms in terms of lighting conditions through a participant questionnaire conducted in the building of the Faculty of Engineering and Technology at Palestine Technical University-Kadoorie in Palestine. The analysis of this study was based on five-point Likert scale questionnaire responses collected from the 60 occupants of the studied building, which shows that 40% of the students were satisfied with the amount of natural light entering their classrooms compared to 35% of satisfied teachers. Moreover, 68% of students are very dissatisfied when asked about the lighting conditions during the summer months inside the classroom, which is agreed with by 65% of very dissatisfied teachers. From the results of an accomplished questionnaire, it can be concluded that all respondents were nearly satisfied with the natural lighting conditions inside their classrooms and strongly dissatisfied with lighting conditions during the summer season. Moreover, this study provides a better understanding of how occupants perceive the indoor lighting environment.**

Keywords: **Lighting, Student's Satisfaction, Post Occupancy Evaluation, Classroom**

I. INTRODUCTION

The educational system is greatly influenced by the way classrooms are designed, and one important factor affecting students' performance and well-being is visual comfort (Vaezzade & Alinia, 2014; Estakhr & Saberi, 2017). The lighting in classrooms, both artificial and natural daylight, is one of the environmental factors that has a direct impact on the ability of learners to concentrate, finish visual tasks quickly, and sustain cognitive function throughout the day (Geng, 2024). As a result, when designing educational buildings' layout and occupancy plans, visual comfort must be given top priority.

By measuring user satisfaction under three lighting scenarios which are natural lighting, artificial lighting, and combination lighting, this study focuses on analyzing visual comfort in classrooms at Palestine Technical University – Kadoorie (PTUK) in Tulkarm, Palestine (Udayakumar et al., 2023; Biswas et al., 2024). A healthy and effective learning environment in the classroom depends on these elements (García & Fernández, 2025). In accordance with (Kong & Jakubiec, 2021), who mentioned in their research that the lighting environment is a principal function in supporting students' visual tasks and academic performance (Kong & Jakubiec, 2021). Moreover, visual comfort was defined by the Illuminating Engineering Society of North America as an important human need that affects their task performance, health and safety, mood, and atmosphere (IESNA, 2000).

This study uses the Post-Occupancy Evaluation (POE) approach to assess lighting performance from the viewpoint of the occupants (Pastore & Andersen, 2018). This approach is widely acknowledged as a crucial feedback mechanism for determining if building performance meets user needs after construction and occupancy. During the five stages of the building process, which consist of planning, programming, design, construction, and occupancy of a building, the post-occupancy evaluation evolved to fill the gap in the conventional building process (Mustafa, 2017). Therefore, POE is a very useful tool for enhancing the design of future educational institutions, particularly in conditions where performance metrics, user comfort, and energy efficiency are becoming more and more crucial.

The important connection between lighting quality, energy efficiency, and occupant well-being in educational settings has been emphasized more and more in recent years by international studies. For example, Çelik reviewed the effects of classroom lighting on students' emotional and cognitive states as well as the energy requirements of educational facilities (Çelik et al., 2024). In 2025, Aghajari created an ideal lighting design model in another study that emphasizes the significance of glare reduction and uniform illumination in classrooms while establishing a balance between energy usage and visual comfort (Aghajari & Chen, 2025). Additionally, Cochran Hameen and others developed a strong procedure for doing Post-Occupancy Evaluation (POE) of schools, showing how occupant-centered and energy-

efficient design upgrades may be guided by a systematic assessment of indoor environmental quality, including illumination (Cochran Hameen et al., 2020).

The real research problem has been formed due to the absence of any previous post occupancy evaluation studies that were done in the West Bank region of Palestine, especially for university buildings or other similar educational buildings. So, the main goal of this study is to evaluate the respondent's satisfaction level with Palestine Technical University-Kadoorie (PTUK) in Tulkarm, Palestine. Also, the results of this research and findings may give practical recommendations for the lighting design of new buildings. In order to produce evidence-based recommendations that can guide the lighting design of future educational buildings in Palestine and similar contexts, the research objective is to assess the satisfaction levels of occupants, focusing on teachers and students, with regard to classroom lighting conditions at PTUK.

II. Literature Review

Evaluating educational buildings according to their ability to enhance occupant comfort and performance, particularly with regard to lighting quality and visual comfort, has received more attention in recent years. Lighting is an essential component of classroom design since it has been revealed to affect students' focus, wellbeing, and academic performance.

Numerous studies have used the Post-Occupancy Evaluation (POE) methodology, which places an emphasis on obtaining user feedback resulting from building occupancy, to evaluate such impacts. POE is well known for being a trustworthy technique for assessing indoor environmental quality (IEQ) in actual use circumstances. In this chapter, the primary findings, methodologies, and research gaps are, most notably, the absence of studies conducted in Palestinian universities along with international and regional studies that used POE to investigate lighting in educational settings. The academic foundation for the current PTUK investigation is provided by this review.

The interior environment of educational buildings has attracted many researchers to investigate those features in order to improve human health and comfort. There is a high correlation of 88% between building performance features and user satisfaction, a result of Iraqi research done in university buildings with a survey of 500 respondents, which emphasizes the importance of POE in future university building improvements to meet user requirements (Mustafa, 2017). Also, research conducted in eight government and public buildings in Putrajaya, Malaysia, shows that there is a correlation of 74% of the features of building performance with occupants' satisfaction. This survey included 133 respondents and used SPSS as a statistical analysis tool (Khalil & Nawawi, 2008). Moreover, researchers in Ghana recommended improving the school physical environment to enhance student performance after using a multi-stage sampling technique in descriptive survey research and using simple random sampling and regression model analysis in their study (Baafi, 2020).

Norazman and others stated that the highest satisfaction was in visual comfort with 3.9987 followed by cleanliness with 3.6675 and the less comfortable were with noise pollution and thermal comfort. They recommend improving the environmental conditions inside the studied classrooms based on the discussed findings. They used a Likert scale survey and semi-structured interviews with 382 students and 35 experts, which contained 181 males and 201 females. Their study was done in a secondary school building in Malaysia with the aim of evaluating the satisfaction level and perception of students with their classrooms' comfort level (Norazman et al., 2021). Another study done by Samani in a Malaysian educational building with 150 students concluded that it is essential to improve lighting in learning environments to enhance students' learning performance and help motivate them to learn more. This study aimed to evaluate the influence of indoor lighting on the learning performance of students within learning environments and used SPSS software as an analysis tool (Samani & Samani, 2012).

In addition, post-occupancy evaluation research was conducted through surveys and on-site measurements of lighting and thermal conditions, involving the evaluation of user perceptions of comfort related to light and air quality and assessing the impacts on user performance and comfort. The survey contains 138 participants, including 88 students and 50 teachers from the ETS-UESC building in Brazil. The result shows that the quality of natural lighting despite illuminance being above the recommended limit, as answered by 80% of users. Also, the need for active or passive technical solutions was clearly highlighted in the study to mitigate these issues and emphasizing the importance of considering environmental comfort in the design of educational spaces (Carvalho et al., 2022). On the other hand, a study conducted in university classes in Taiwan determined that over 70% of the respondents experienced adverse physical symptoms and nearly 50% of the respondents felt lighting conditions were not ideal for tasks. The study examined the quality of the classroom lighting and students' visual comfort using high-dynamic range image (HDRi) photography besides surveys to determine user satisfaction. They involved 122 students (Chiou et al., 2020).

In 2022, researchers conducted a POE to measure two educational buildings performance in terms of indoor environmental quality (IEQ), energy consumption, and occupant satisfaction using the Building Use Survey (BUS) methodology. Their results show that occupant satisfaction is lower than the benchmark data for thermal comfort in both summer and winter, the quality of the indoor environment, and the key components of the building's overall design. The building management team has been notified of the POE assessment's findings in order to create high-performance building operation guidelines. (Zhao & Yang, 2022). In a study in the UAE of higher education building, POE revealed

dissatisfaction with thermal comfort and lighting, specifically in the measured lux levels that revealed to be excessive with 100% above recommendations from the WELL building standard and about 19% of the occupants reported "too much artificial lighting" (Kim et al., 2022).

Shamil and Eldhose pointed out that post-occupancy evaluation remains significantly underutilized in residential contexts, even though they hold considerable promise in identifying performance issues and informing targeted retrofits (Shamil & Eldhose, 2023). Furthermore, a study done by Meng and others showed that the classroom lighting quality after the evaluation had done through POE and physiological measurements there is a measurable effect on children's attention and mental health (Meng et al., 2023). In addition, to be able to report a greater environmental satisfaction level, we should give the class users, especially the students, the controlling right of lighting elements to adjust them according to their needs. This will positively affect the classroom design and help the users to have a better mood and task performance than those without control (Veitch & Newsham, 2000).

More than 90% of the POE literature that was examined used questionnaire-based techniques as a main and firstpriority approach, frequently in conjunction with instruments like lux meters for lighting measurements. This is in line with a significant global trend toward user-centered assessments, particularly when it comes to visual comfort in learning environments. To properly measure subjective satisfaction, the majority of research employed Likert rating scales. Thus, the 5-point Likert scale questionnaire used in this study is methodologically sound and compliant with global best standards. Additionally, research on POE that focuses on lighting in university classrooms in Arabic and Palestinian is noticeably lacking.

This surveyed study addressing that need, providing localized perspectives from a university building in Tulkarm, and emphasizing evidence-based design for visual comfort in the regional educational environment.

III. METHOD

The methodology for the post-occupation evaluation inspection questionnaire was conducted on the building of the Faculty of Business and Economics at Palestine Technical University-Kadoorie (PTUK) in Tulkarm, Palestine, within the classes located on the first floor of this building. The classrooms at this location were chosen because they are typical of PTUK's teaching facilities, hosting daily lectures for sufficient numbers of learners and being often used by faculty. Additionally, Tulkarm's Mediterranean environment, which features hot, dry summers and moderate, rainy winters, makes it an ideal location to assess the effects of seasonal change on the comfort of artificial and natural illumination.

This research is done by using a paper-based questionnaire that was distributed to the 60 respondents, divided into 20 teachers and 40 students. In order to maintain manageability within the parameters of a single-building case study, the sample size was chosen to ensure a balanced representation of both instructors and students. By reflecting the true user profile of the classrooms, the teacher-to-student ratio guarantees that both viewpoints are fairly taken into account during the evaluation process. Thus, throughout the academic semester, the space is actively occupied by both teaching staff and students. The simple random sampling technique was used to choose the participants, giving any person who was present in the designated classrooms throughout the distribution period. Both teachers and students have an equal chance of being chosen. This methodology makes certain the elimination of bias regarding selection and sustains the sample's representativeness for typical classroom users.

1. This collected data is considered primary data collected for this study that is concentrated on the occupant's satisfaction level through post-occupancy evaluation regarding lighting aspects in the classes across six dimensions, which are overall comfort level, artificial lighting comfort level, natural lighting comfort level, lighting conditions during summer, lighting conditions during winter, and personal control over lighting elements inside classes. These lighting dimensions are chosen upon the International POE frameworks and the earlier literature studies that highlighted lighting quality as a crucial element of indoor environmental quality (IEQ) in educational facilities. This questionnaire mainly used a five-point Likert scale system, which consists of Very Dissatisfied, Dissatisfied, Neutral, Satisfied, and Very Satisfied. The Likert scale was chosen because it offers a straightforward yet reliable method of measuring subjective user satisfaction and is frequently used in POE research because it enables comparisons across various user groups and educational situations (Guo & Sui, 2025).

To enable comparative understanding, the responses were categorized and examined independently for teachers, students, and the entire sample group after data collection. Since professors typically spend longer continuous hours in the classroom with a relatively fixed position near the board for teaching, and students' perceptions are frequently shaped by factors like shorter occupancy durations, varying seating arrangements, and reliance on visual activities during lectures, this separation was especially important. Microsoft Excel was used for data analysis, allowing for the computation of fundamental statistical measures as well as the production of tables and column charts that graphically depicted satisfaction levels. To make it easier to understand trends, percentage distributions were computed to show how each satisfaction level was represented within the entire respondent group. By concentrating on descriptive statistics, the analysis intended to give a concise summary of user

experiences, spot recurring trends, and draw attention to certain problem areas that can help guide useful suggestions for classroom lighting design.

The full methodology framework is shown in Fig 1 to present the entire research process, from survey design to data analysis and suggestion creation. This figure describes the study's logical and sequential phases, which include after Identifying the problem and establishing the objective; 1. Site selection, 2. Developing the questionnaire and sampling, 3. Gathering data according to each lighting criterion 4. Analyzing and visualizing the data to end with interpreting the findings and developing recommendations based on user input. In the overall picture of post-occupancy evaluation for classroom lighting, using this proper methodology approach ensures the reliability of the method and improves the validity of the results.

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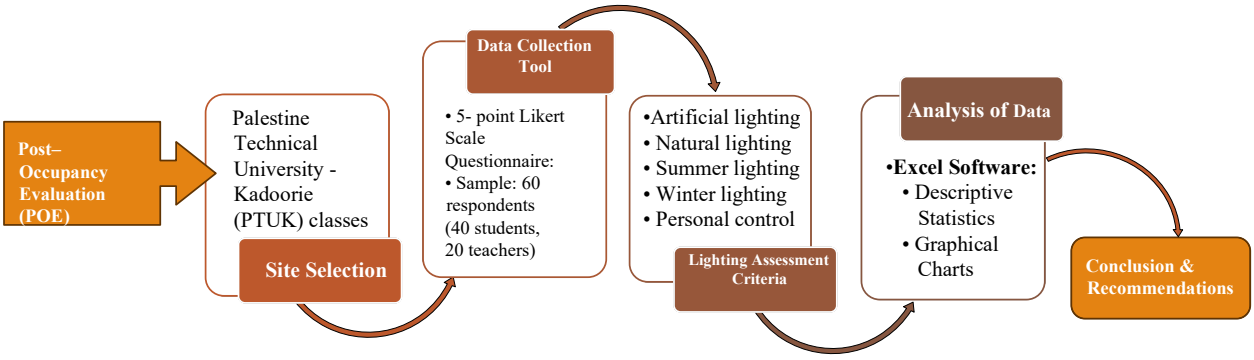

Fig. 1 Methodology Framework

Throughout the research, ethical issues were also preserved. All respondents were made aware of the study's goals prior to filling out the survey, and participation was optional. To maintain privacy and confidentiality, no personal identifiers were gathered, and the replies were examined in a statistical manner.

IV. Results and Discussion

With an emphasis on user satisfaction with different classroom lighting settings, this chapter provides and examines the findings of the post-occupancy evaluation (POE) survey carried out at Palestine Technical University – Kadoorie (PTUK). Descriptive statistics and graphical representations are used to analyze the data along three main dimensions: individual control, seasonal fluctuation, and natural and artificial lighting.

The chapter gives findings on how lighting affects user comfort and the classroom experience by contrasting teacher and student answers. The results are examined in light of regional climate and educational requirements, providing a foundation for well-informed design suggestions in the following chapter.

The Overall Respondents' Analysis

The following section presents the distribution of user satisfaction levels regarding various lighting conditions in the assessed classrooms, based on the conducted questionnaire responses. Obviously, fig 2 indicates that overall satisfaction with natural lighting was highest, with 63% of students expressing satisfaction and 23% expressing very satisfied, indicating an effective architectural design for utilizing natural lighting within classrooms. İn contrast, the highest dissatisfaction percentage was recorded when evaluating lighting conditions during the summer season, with 67% reporting they were very dissatisfied and 25% dissatisfied, with no satisfaction ratings at all. These results reflect severe discomfort likely caused of overheating or poor shading in hot climates like Palestine, indicating a lack of integration between lighting and thermal comfort. Regarding artificial lighting, 43% of votes expressed dissatisfaction, while only 20% were very satisfied, which emphasis the openion in lighting overall conditions that shows around 35% of the participants voted to dissatisfied and very dissatisfied opotions. Additionally, when comparing the votes of personal control over lighting elements, it was notably that

about 32% were very dissatisfied and 27% were dissatisfied, with only 15% indicating satisfied and very satisfied.

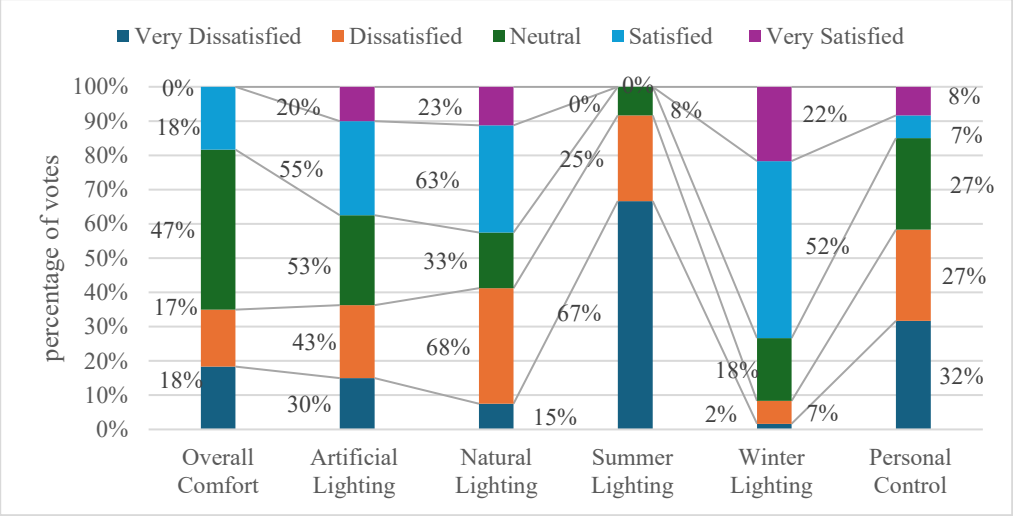

Fig. 2 All respondents' satisfaction with different conditions

The descriptive statistics of students' satisfaction with six important components of classroom illumination are shown in Fig. 3. The line-plots represent the values of standard deviation and standard error, alongside barcharts that represent both the mean and mode values. The analysis shows that natural lighting and artificial lighting received moderate satisfaction with means of 3.10 and 2.93, respectively, with relatively high consistency (St.Dev.=1.3; St. Err. = 0.2). In contrast, winter lighting conditions achieved the highest satisfaction, with a mean of 3.85 and a mode of 4, paired with the lowest standard error of 0.1, indicating highly consistent approval among respondents. On the other hand, individual control over illumination and summer lighting conditions, scored much lower (Means = 1.80 and 2.33; Modes = 1), despite with moderate standard deviations of 0.6 and1.2, respectively.

These values suggest not only dissatisfaction but also broad consensus regarding these shortcomings.

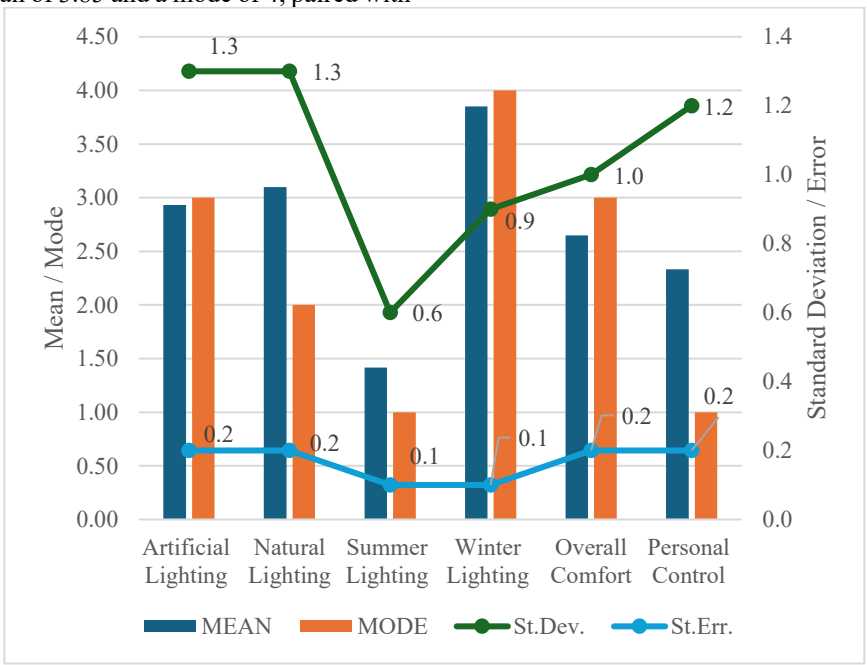

Fig. 3 Descriptive Statistics of Lighting Satisfaction with Different Conditions

Participants were divided into two groups, teachers and students, to provide for a more accurate assessment of user impressions of the different lighting settings in the classroom. Twenty teachers and forty students responde to the questionnaire. To take into consideration possible variations in experience and perception, the data from each group was examined separately. Based on the distinct input from every user type, this stratified analysis facilitates the production of focused conclusions and more context specific recommendations.

The Student Respondents' Analysis

According to Fig 4, only 38% of students expressed dissatisfaction with artificial lighting (30% very dissatisfied and 8% dissatisfied), but 51% of students said they were content with the natural lighting in their classrooms (28% satisfied and 23% very satisfied). Compared to 13% for natural lighting, 28% of respondents had neutral views about artificial lighting. Based on more balanced and positive replies, these results imply that students usually view natural illumination more favorably than artificial lighting. The findings also show that a 38% of students are unhappy with artificial illumination, which calls for further consideration in classroom design.

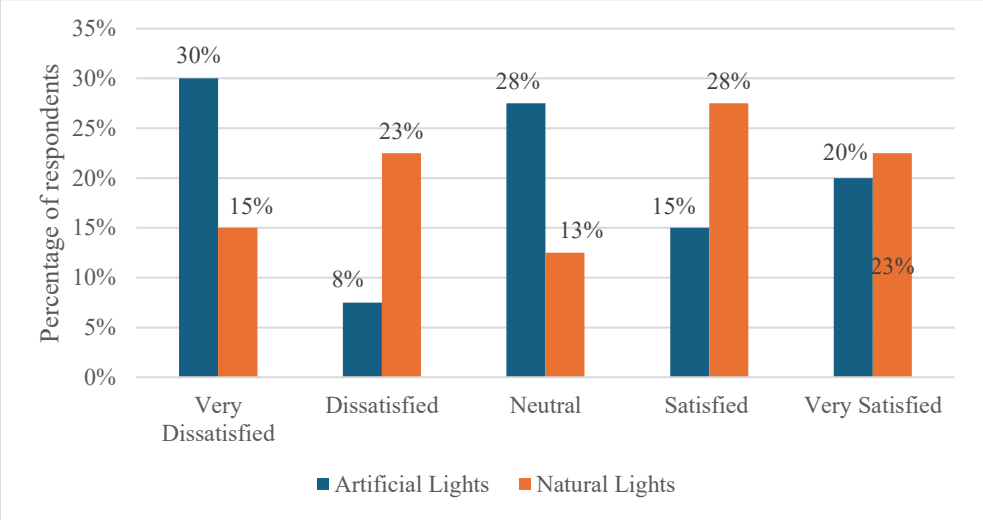

Fig. 4 Students' Satisfaction with Classroom Lighting Quantity

Fig. 5 shows that the majority of students (83%) expressed pleasure with the illumination in their classrooms over the winter, with 55% saying they were satisfied and 28% saying they were very satisfied. On the other hand, only 3% of respondents were unsatisfied and 3% were very dissatisfied over the winter. In contrast, 68% of students expressed very dissatisfaction with the summer illumination conditions, while 20% expressed dissatisfaction. Remarkably, only 13% of students reported having neutral thoughts on summer lighting, and none of them expressed satisfaction. These results show a significant seasonal variation in students' perceptions of lighting conditions, with winter conditions being significantly more favorable.

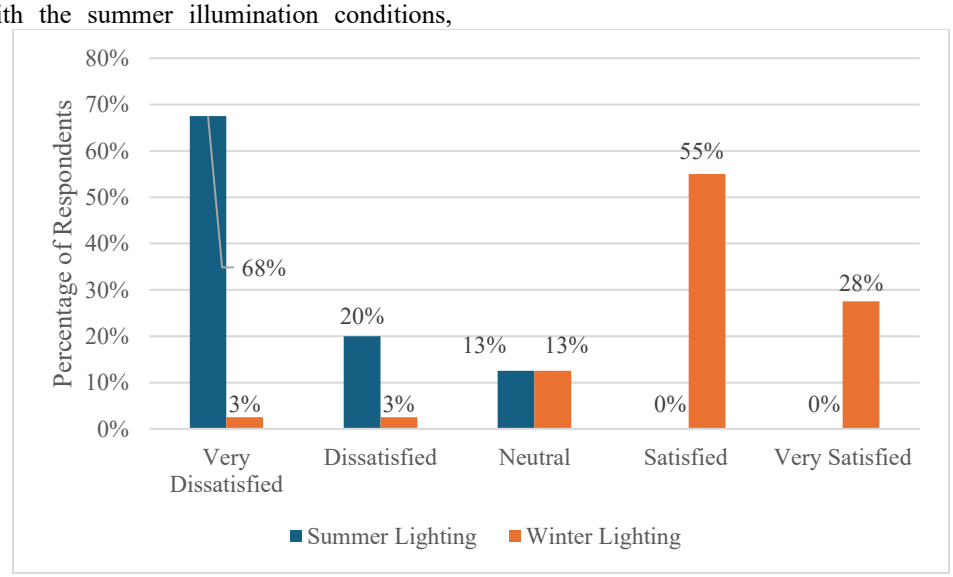

Fig. 5 Students' Satisfaction with Classroom Lighting Conditions in Summer vs. Winter

Based on Table I, Significant variations in satisfaction scores across lighting conditions are shown by the descriptive statistics. Summer lighting earned the lowest mean satisfaction score (M = 1.45), while winter lighting had the best (M = 4.03), followed by natural lighting (M = 3.20) and artificial lighting (M = 2.88). These findings show that perceived lighting comfort is clearly influenced by the season. These trends are further supported by the mode values, which show that although artificial and summer lighting recorded a mode of 1, suggesting widespread dissatisfaction, winter and natural lighting conditions had a modal value of 4, showing a significant tendency toward

satisfaction. Remarkably, the summer lighting standard deviation (St.Dev. = 0.7) was one of the lowest, indicating that participant answers were consistent.

TABLE I DESCRIPTIVE STATISTICS OF STUDENTS' SATISFACTION WITH CLASSROOM LIGHTING CONDITIONS

	Artificial Lighting	Natural Lighting	Summer Lighting	Winter Lighting
MEAN	2.88	3.20	1.45	4.03
MODE	1	4	1	4
Standard Deviation	1.5	1.4	0.7	0.9
Standard Error	0.2	0.2	0.1	0.1

The Teacher Respondents' Analysis

Teachers' satisfaction responses with artificial and natural classroom lighting are shown in Fig 6. With 35% of respondents expressing dissatisfaction with artificial lighting and 45% with natural lighting, dissatisfaction was the most commonly expressed votes. For artificial and natural lighting, the percentage of neutral responses was 25% and 20%, respectively. With 35% of teachers expressing satisfied with natural lighting and 40% with artificial lighting, the satisfaction levels were comparatively comparable. Because no teacher expressed very satisfaction or very dissatisfaction with either form of lighting, it is noteworthy that no responders chose the extremes of the scale.

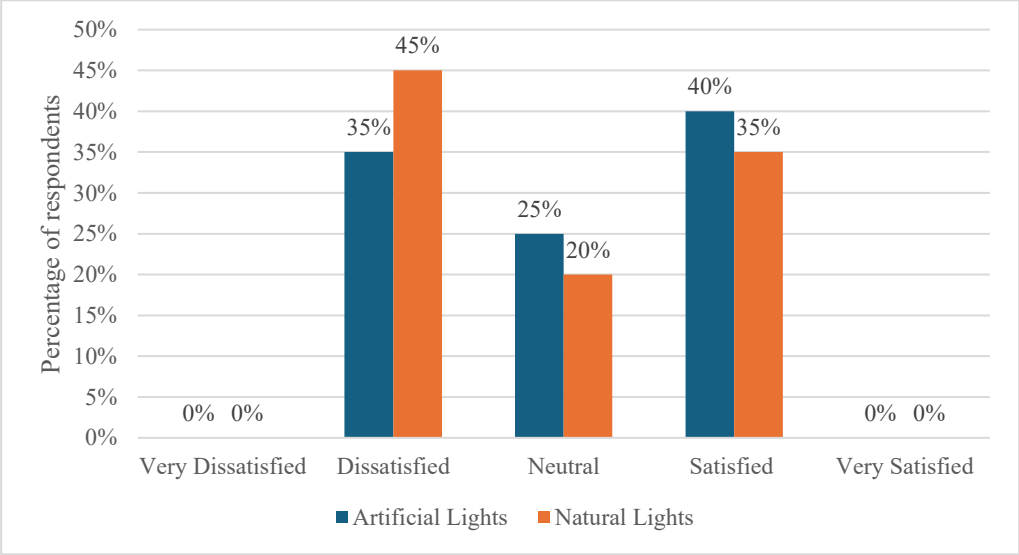

Fig. 6 Teachers' Satisfaction with the Classroom Lighting Quantity

Teacher responses clearly express dissatisfaction with the illumination in the classroom on summer days, as shown in Fig 7, with 65% expressing very dissatisfaction and 35% expressing dissatisfaction. None of the respondents expressed satisfaction or even a neutral view; thus, all teachers indicated negative opinions. This implies that summertime lighting conditions cause a great feeling of discomfort. In comparison to winter days, around 55% of teacher respondents are pleased with lighting conditions, distributed between 45% of satisfied views and 10% of very satisfied views. This suggests that teachers had a more positive opinion of lighting during the colder months.

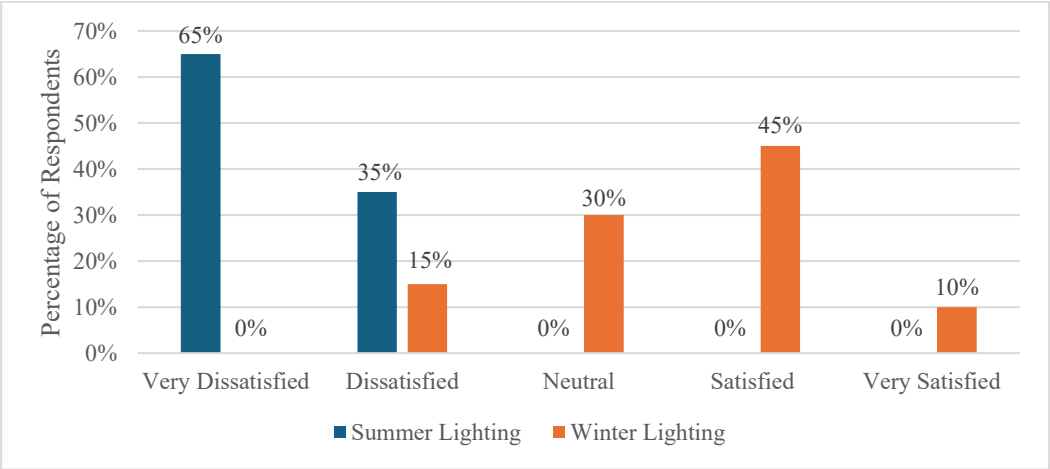

Fig. 7 Teachers' Satisfaction with Classroom Lighting Conditions in Summer vs. Winter

According to Table II, teachers were most satisfied with winter lighting (Mean = 3.50; Mode = 4), with artificial lighting coming in second (Mean = 3.05; Mode = 4). Summer lighting obtained the lowest ratings (Mean = 1.35; Mode = 1), showing a definite discomfort during warmer months, whereas natural lighting was rated with moderate satisfaction (Mean = 2.90). Teachers' dissatisfaction with seasonal lighting discomfort is consistent, as seen by the relatively low standard deviation and standard error values across all categories, especially for summer illumination (St.Dev. = 0.5; St. Err. = 0.1).

TABLE II DESCRIPTIVE STATISTICS OF TEACHERS' SATISFACTION WITH CLASSROOM LIGHTING CONDITIONS

	Artificial Lighting	Natural Lighting	Summer Lighting	Winter Lighting
MEAN	3.05	2.90	1.35	3.50
MODE	4	2	1	4
Standard Deviation	0.9	0.9	0.5	0.9
Standard Error	0.2	0.2	0.1	0.2

Distinct trends in user satisfaction with different classroom lighting conditions at PTUK were found by the analysis. Overall, summer lighting and the absence of personal control over lighting systems regularly got the lowest satisfaction ratings from both teachers and students, while natural lighting and winter lighting conditions were evaluated most favorably. These results highlight unique issues in lighting operation and design, especially with regard to flexibility and user-responsiveness.

This chapter emphasizes the significance of incorporating more adaptable and efficient lighting techniques in learning environments by highlighting key areas of concern, particularly deficient performance during the summer and restricted user control. The findings give the design suggestions discussed in the next chapter a targeted practical validity.

V. Conclusion

In order to determine user satisfaction with different classroom lighting conditions, this study carried out a postoccupancy evaluation (POE) at Palestine Technical University – Kadoorie. The findings show that whereas summer lighting conditions were consistently regarded as the least satisfactory, winter lighting and natural daylight were highly commended by both teachers and students. 55% of students said they were satisfied with the winter lights, however 68% said they were very dissatisfied with the summer lighting. Teachers were reported to have even more negative reactions to summer lights, with 65% of them expressing very dissatisfaction and 35% expressing dissatisfaction.

Interestingly, students and teachers' satisfaction with artificial and natural lighting did not differ substantially, suggesting that the seasonal variation significantly impacts perceived comfort rather than the lighting source itself. With mean scores of 4.03 and 3.50, respectively, students and teachers were most satisfied with winter lighting, while summer lighting was rated as the least satisfactory with 1.45 for students and 1.35 for teachers. Responses from both groups were similar, indicating a moderate level of satisfaction with artificial and natural lighting.

These results emphasize how essential it is to put in place adaptable, user-centered lighting strategies that improve occupant management and incorporate seasonal variations. Additionally, this study provides concrete proof in favor of enhanced visual comfort in classroom settings and highlights the need of post-occupancy evaluation in guiding lighting design decisions in higher education environments.

VI. Recommendations

Some significant recommendations are made to improve the lighting conditions and general user comfort in university classrooms in regard to the findings of this post-occupancy evaluation:

1. Use Adaptive Lighting Systems: It is advised that classrooms should be equipped with dynamic lighting systems that adapt intensity to seasonal and daylight variations, as there is a notable need for more studies regarding light intensity in classrooms during different seasons.
2. Expand User Control Over Lighting: One of the most often mentioned sources of discomfort was the absence of personal control over lighting components. Giving the teachers in particular a control rights on lighting like task lighting or dimmable switches could increase their level of pleasure and productivity.
3. Promote more thorough environmental audits and POE assessments of lighting conditions: The integration of regular post occupancy assessments into facility management procedures will guarantee that occupant input consistently influences lighting plans and space enhancements.

Scientific Ethics Declaration

This research study complies with research and publishing ethics.

Conflict of Interest

The authors declare no conflict of interest. This research study complies with research and publishing ethics.

Funding No.

Acknowledgements or Notes

The authors are grateful to Palestine Technical University-Kadoorie and Universiti Sains Malaysia (USM) for their support to conduct this research.

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