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RESEARCH ARTICLE

DETERMINATION OF LIGHTING LEVELS IN CLASSROOMS OF A UNIVERSITY IN MEXICO

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ABSTRACT

Lighting in classrooms refers to the entire set of devices that are installed to produce lighting effects. This aspect, although largely ignored, is of utmost importance in the development and learning of students within classrooms, laboratories and different educational sites. learning in schools. Their good or bad implementation has a great impact on teaching results, performance and fatigue for all those who use them. The objective of the research was to evaluate the lighting levels in the classrooms of a university in Mexico in accordance with the guidelines of NOM-025-STPS-2008. The lighting levels were evaluated in 16 classrooms distributed in two buildings. To determine the lighting of the classrooms, a Sper Scientific 840010 Pocket / Mini Light Meter was used. In the morning shift, only 51% of the total classrooms met the standard, during the afternoon shift, 88.88% of the classrooms on average met the standard. It is necessary to provide maintenance to the luminaires inside the classrooms so that they provide the amount of e lux indicated by the legislation. It is important to have good lighting inside the classrooms since it will allow greater comfort for the students and therefore better learning. Monitoring the lighting levels in the classrooms periodically will allow us to detect those where the lighting level does not comply with the provisions of NOM-025-STPS-2008.

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INTRODUCTION

Good lighting is of utmost importance in the development and learning of students within classrooms, laboratories and different learning sites in schools. Their good or bad implementation has a great impact on teaching results, performance and fatigue for all those who use those (Posada & Valencia, 2013). Poor lighting can cause a series of eye problems ranging from eye fatigue, tiredness, stress, and even headaches or migraines, which can cause accidents and difficulties in the teaching-learning process.

This is why a balance is sought in the quantity, quality and stability of light, using it as a complement to natural light, to have a perfect harmony of luminosity in the site (Flores, 2017). Human beings perceive all information mainly through their senses, one of the main ways to adjust to their environment is vision, since it allows the possibility of differentiating objects, whose appreciation is directly linked to the proportion of light that they reflect or transmit. . If lighting is poor, objects are poorly distinguished, low performance in activities is detected, and serious accidents to people and/or damage to equipment or materials can occur.

On the contrary, if the lighting is correct, the contours are revealed, it becomes easier to visualize them, visual fatigue is reduced, morale is raised, activities are easier to carry out, and accidents are reduced (Álvarez, 2020). Studies have been carried out to measure lighting levels in education centers in order to know if they are adequate for the learning process. An evaluation of the lighting system installed in classrooms of the Mazatlán technological institute was carried out, two different classes of classrooms were evaluated according to the NOM-025-STPS-2008 standard, the results showed that the lighting is insufficient to reach the minimum value according to the standard, which is 300 lux (González et al., 2017). Likewise, an environmental lighting study was carried out in the area of education for work at the Tupac Amaru Huancayo Polytechnic, measurements of artificial lighting were carried out in all the environments of the educational institution where the students and teachers of the campus interact, in which An interrelation could be observed in the lighting variables and the effort of visual acuity, that is to say that their conclusion was that there is an influence between the ambient lighting and the effort of visual acuity in the students of the polytechnic, it also allowed us to understand the excess of illumination can cause vision problems (Ramos, 2017).

Álvarez (2020), in his research "Quality of lighting in classrooms in a higher education institution", aimed to determine the quality of lighting and improvement strategies in classrooms in an educational institution. above, illuminance measurements were made in the classrooms, as well as illuminance uniformity, glare index, overall color rendering index and nominal colorimetric temperature of each lamp, in 15 classrooms during the three class times, The results obtained were that the lighting in the morning and afternoon was met in the majority of the classrooms, but not at night, as well as that in the day and afternoon there were classrooms with excessive levels of lighting and during the night there were classrooms with levels well below what is recommended. In conclusion, they concluded that the majority of classrooms do not comply with illuminance and uniformity during the 3 schedules. In work areas such as workshops, packaging areas, assembly, classrooms and offices where activities such as moderate distinction of details, simple assembly, medium bench and machine work, simple inspection, packaging and office work are carried out, the minimum level the lighting level is 300 lux and the maximum permissible levels of the reflection factor are 50% Kf. It is considered that there is glare in the area and workplace when the value of the reflection factor (Kf) exceeds the established values. The objective of this research was to evaluate the lighting levels in the classrooms of a university in Mexico according to the guidelines of NOM-025-STPS-2008 and determine if it complies with the established minimum limits and from this propose strategies so that lighting is not a factor that affects the teaching-learning process.

MATERIALS AND METHODS

To carry out the lighting measurements in the university classrooms, a Sper Scientific brand Luxmeter / Mini Light Meter model 840010 pocket, measuring tape, calculator and a notebook were used to record the results of the measurements.
In this study, data on the light levels and reflection index of all the study classrooms were obtained, through the methods stipulated in NOM-025-STPS 2008, averages were obtained from each classroom at 3 different times of the day in the that classrooms are used to teach classes. Measurements of the reflection factor of the classroom walls were also carried out in accordance with what is indicated in the standard. Lighting measurements were carried out in two buildings of the university, there were 7 classrooms in building E, all the classrooms in building E are located on the third floor, and 9 classrooms in building A, the classrooms in building A, six Of them are located on the second floor and the other three on the third floor. These classrooms have a capacity of between 30 and 40 students. Work tables with seating capacity for two students are used. The classrooms analyzed are located on the first and second floors. The buildings are oriented from east to west and are surrounded by trees. A sampling of the lighting conditions was carried out in the university classrooms during the hours in which classes are taught, in order to collect the necessary data to know if the lighting in the classrooms meets the maximum permissible limits (Sánchez, 2018). Three measurements were carried out for each classroom at different times of the day, trying to cover the three class shifts, the hours were 7am, 1pm and 7pm. The lighting measurement technique and the points sampled within the classrooms were carried out in accordance with the specifications of the Official Mexican Standard NOM-025-STPS-2008. In order to know the opinion of the students who take classes in the classrooms where the lighting measurements were carried out, a survey was applied to record the comments on how they perceive the lighting during the course of the day. The survey was carried out on 17 students who take classes in the different classrooms of the two buildings where the measurements were carried out to find out their perception and opinion regarding their lighting systems.

They were asked a total of three questions and a suggestion was asked to improve the lighting inside the classroom.

- How would you rate the classroom lighting?
- At what time of day do you feel the lighting is most deficient?
- What do you think is the biggest lighting problem in the classroom?
- Do you have any suggestions to improve classroom lighting?

Statistical analysis: At the end of data collection, a descriptive analysis of what was obtained was carried out to evaluate and describe the lighting conditions of the classrooms, with which the average in luxes of the classrooms, the classrooms that comply and those that do not comply can be observed. with the standard, and the average lux that reflects the work planes and the walls that showed incandescence during the measurements. In the event that the data obtained determines that the lighting in the classrooms is not recommended, a plan will be proposed to improve the facilities and therefore improve the comfort of the students and teaching staff in carrying out the activities within the classroom. the spaces analyzed.

RESULTS

The results of the measurements in the classrooms are presented below:

Average lighting building E: Table 1 shows the results of the average lighting levels of building 1

In Figure 1, the results of measuring the lighting of building E are graphed, and the level specified in the standard of 300 lux as the minimum is marked with a line.

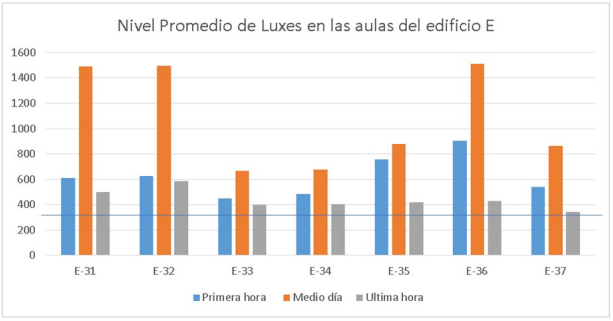

Figure 1. Graph of Average Lux Levels in the Classrooms of Building E (Source: Own elaboration)

Table 2 shows the results of the average lighting levels of building A. The average lighting results of building 2, during the first hour in the classrooms of building A, 49% of the classrooms do not meet the minimum required levels. During the midday hour, 88.88% of the classrooms in building 2 meet the minimum lighting levels. In the last hour of classes, 88.88% of the classrooms in building A do not meet the minimum lighting levels. In Figure 2, the results of measuring the lighting of building A are graphed, and the level specified in the standard of 300 lux as the minimum is marked with a line, which allows us to visualize which classrooms and which shift are the that do not comply with what is specified in the standard.

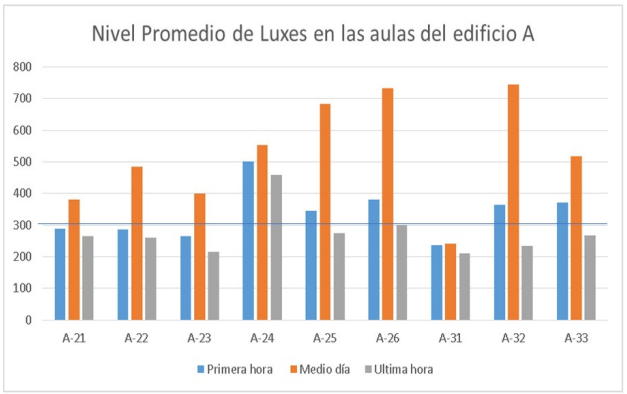

Figure 2. Graph of Average Lux Levels in the Classrooms of Building A (Source: Own elaboration)

Reflection factor (Kf): During the measurements in buildings 1 and 1, only one classroom was in which critical places were observed where the incidence of light was very noticeable. Measurements were taken at these points to determine if the work sites and walls reflected more than allowed by the standard, the result is that neither the work planes nor the walls reflect more than what is allowed by the standard, complying with the required reflection factor.

Survey: The results obtained in the survey carried out on students about their perception of lighting in their study classrooms are presented below:

Question 1

Figura 3. Grafica de Respuestas de la Pregunta 1 (Fuente: Elaboración propia).

Where: 1= very bad lighting, 2= bad lighting, 3= average lighting, 4= good lighting and 5= very good lighting. In which we can see that 52.9% of the students rate the lighting systems as good.

Figure 4. Graph of Choosing the Time with the Worst Lighting According to the Students (Source: Own elaboration).

Question #2: In the second question, half of the respondents came to the conclusion that during the middle of the day the excess lighting that enters through the windows and the reflection effect on walls, blackboards and work tables prevent adequate lighting, thus making it difficult to teaching-learning process.

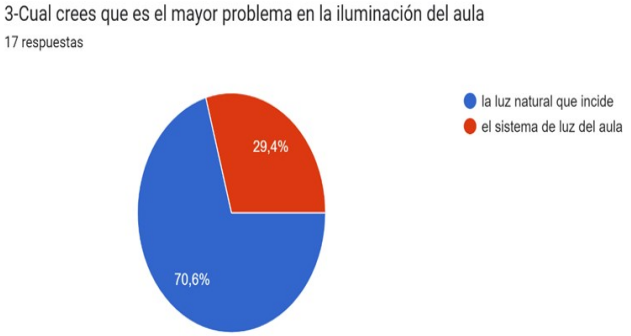

Figure 5. Graph of Responses to Question 3 (Source: Own elaboration)

Question #3: With the third question, it was noted that the greatest dissatisfaction with the lighting in the classrooms is not because of the lamps in them, but because of the natural light that falls during the course of the day.

Question #4: As a fourth question, we asked the students if they had any suggestions to improve the lighting in the classrooms, to which the majority suggested the option of putting curtains, blinds or some type of polarization in the windows to stop the incidence of too much natural light in the rooms Classroom.

DISCUSSION

The results of lighting measurements vary considerably depending on whether it is night or day. The amount of light that enters through the windows during day classes produces a high number of luxes inside the classroom, therefore the reflection on the blackboard, walls and work table can reduce visibility and therefore cause stress in students, thus affecting

Table 1. Average Level in Luxes in the Classrooms of Building E

Classroom	Classroom location	First hour (7:00 am)	Noon (1 pm)	Last hour (7 pm)
E-31	Third floor	609.5833333	1489.833333	501.4166667
E-32	Third floor	624.333333	1496	586.333333
E-33	Third floor	448	666.5	399.666667
E-34	Third floor	484.833333	678.166667	401.333333
E-35	Third floor	758.75	881.166667	420.166667
E-36	Third floor	902.75	1508.75	430.5
E-37	Third floor	540.333333	864.833333	341

Table 2. Average Level in Luxes in the Classrooms of Building A.

Classroom	Classroom location	First hour (7:00 am)	Noon (1 pm)	Last hour (7 pm)
A-21	Second floor	288.45	381.4	265.95
A-22	Second floor	285.3	484.3	260.1
A-23	Second floor	265.6	400.5	214.4
A-24	Second floor	500.8	553.95	458.6
A-25	Second floor	346.35	683.75	273.5
A-26	Second floor	380.2	733.45	299.15
A-31	Third floor	236.25	242.05	210.45
A-32	Tercer piso	363.05	745.2	234.1
A-33	Third floor	370.85	518.65	268.4

the teaching-learning process. During night classes, the lux measurements produced by lighting are not the minimum required by Mexican legislation in this area (300 lux), due to the lack of cleaning of the lamps or the fact that they do not fully function of them, in the same way this produces stress and fatigue in the students as they make a greater effort to be able to visualize what is being presented in class. Although the buildings are surrounded by trees, the classrooms are on the first and second floors, so the foliage of the trees is not high enough to prevent the sun from entering during the day. The construction orientation of the buildings is not in such a way that it would help reduce the amount of light entering the classrooms.

CONCLUSION

With this research it was possible to measure the lighting levels of the study classrooms and compare them with the maximum permissible limits established by NOM-025-STPS-2008, it can be concluded that the teaching - learning process can be affected in the classrooms due to that in some classrooms the limits were lower than those specified and in others the natural light that entered the classrooms was too much that the reflection did not allow the information to be accurately displayed on the classroom blackboards.

It is important to remember that certain aspects of human comfort, such as our mental and physical health or our level of fatigue, are affected by the lack or excessive lighting in the places where we carry out our activities, such as the teaching-learning processes within the classrooms. , in the case of the evaluated classrooms in buildings A and E, most of them met the limits established in NOM-025-STPS-2008, however some students experience a sensation of excessive light which could not allow them to observe and understand what is shown on the blackboard by the teachers, so among the suggestions they propose is to polarize, put curtains or paper on the windows. From the point of view of health at work, performance and visual comfort is exceptionally important, because insufficient lighting can prevent learning in the classroom from being diminished, or the student experiencing a headache. , fatigue, stress from poor lighting.

It is necessary that the staff of the educational centers in charge of the construction and maintenance of the classrooms know the official Mexican standards of the Ministry of Labor and Social Welfare (STPS) that aim at the occupational health and safety of people, it is important In the case of educational centers, good lighting in the classrooms will allow greater comfort for the students and therefore better learning. Monitoring the lighting levels in the classrooms periodically will allow us to detect those where the lighting level is not adequate complies with the provisions of NOM-025-STPS-2008. Apart from complying with the lighting levels established by the standard, energy efficiency measures aimed at saving are currently required. Such as the use of LED technology or the use of natural light can help you save and as it was possible to observe the classrooms that comply with the standards for the most part it is thanks to this, in the same way thinking about alternative energies such as the sun would help have sustainable universities.

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