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ASSESSING THE VIABILITY OF ILLUMINATION IN THE ARCHITECTURE CAMPUS'S CLASSROOM AND STUDIO CASE STUDY: CLASSROOMS AND STUDIOS AT UNIKOM

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Abstract

Lighting plays a fundamental role in supporting human activities, especially in learning environments. The goal of this research is to evaluate and improve the lighting conditions in the architecture classroom and studio on the 7th floor of UNIKOM's Smart Building, as improper lighting can reduce concentration, cause visual fatigue, and create discomfort for users. This study applies an experimental research method with a mixed-method approach, where the intensity of room lighting was measured according to the SNI 03-6575-2001 standard using a lux meter. The data were then modelled with Relux software and visualized through Blender to propose optimized lighting designs. The results show that the existing lighting in both rooms does not fully meet the recommended standards, while the proposed models provide more uniform and sufficient illumination. The conclusion of this study emphasizes that implementing the improved lighting design can enhance comfort, support better concentration, and serve as a practical reference for similar classrooms and architecture studios in the future.

Keywords: Classrooms, Feasibility of lighting, Lighting, Lighting Studies, UNIKOM.

1. Introduction

Lighting is an important factor in space design. Lighting in the room allows people who occupy it to see objects. Lighting is one of the important physical environmental factors in carrying out an activity, and light is needed by the eye to recognize a visual object. Good lighting certainly creates a comfortable and safe environment that supports health when carrying out activities [1]. Meanwhile, poor lighting causes eye fatigue and can even cause sore eyes [2]. Eye fatigue is eye muscle tension due to long-term use of vision in uncomfortable conditions. As a result, it can increase workload, tire easily, and decrease productivity and concentration. The studio room is a very important space for architecture students [3]. Therefore, the studio room should be designed with the correct lighting. Apart from that, classrooms are no less important because based on the SNI and the Decree of the Minister of Health, each room has specific lighting standard [4].

The problem that underlies the experimental research on the illumination of the rooms on the 7th floor of UNIKOM smart building is that the rooms which are not directly exposed to sunlight do not get optimal lighting, while rooms exposed to direct light do. In the end, the comfort of the rooms is disturbed causing visual fatigue and decreased student's concentration and productivity [5]. Another problem is the waste of energy expended due to a lack of natural lighting; therefore, artificial lights must be used [6].

Based on the literature review and research that has been done, the use of appropriate light can increase activity productivity and increase focus. Using good light can also increase concentration in classrooms and studios, so that learning can be done effectively. Thus, it is necessary to use the proper light intensity in classrooms and studios on the 7th floor of the UNIKOM Smart Building.

2. Research Method

The method used in this study is experimental research one with a mixed method approach (qualitative and quantitative), in which primary sources of information are taken based on field observations and secondary sources through research journals, and several calculations are performed based on Indonesia national standard - SNI 03-6575-2001 regarding lamp illumination standards. Experiments were carried out by measuring the illumination of several light points in the classroom and studio. The tool used in this experiment is a lux meter via an iPhone smartphone.

Furthermore, the modelling process is conducted using Relux and Blender software for a better visualization. Illumination measurements were conducted in Classroom 7.021 and Studio 7.009 with the assistance of four students who supported the data collection process. The measurements were carried out in empty classrooms to eliminate interference from ongoing activities and ensure consistency of results.

Illumination levels were recorded at several predetermined points using a calibrated lux meter application on a smartphone, focusing on desk areas and circulation zones. The obtained data were then evaluated against SNI 03-6575-2001 standards and further processed through Relux and Blender software to visualize potential improvements in lighting distribution.

3. Results and Discussion

Lighting is one of the factors for obtaining a safe and comfortable environment and is closely related to human productivity [7]. Light intensity is the amount of light that can illuminate each unit surface area of the room (see Table 1). Artificial lighting systems often used can generally be divided into three types:

(i) Uniform lighting systems, directional lighting systems, and local lighting systems. In an even lighting system, the light illumination is spread evenly throughout the room. This lighting system is suitable for rooms that are not used to perform special visual tasks, and several armatures are placed regularly across the ceiling.

(ii) In a directional lighting system, the entire room gets lighting from one particular direction in this system. This system is suitable for the exhibition or

(iii) protrusion of an object because it will appear clearer. Furthermore, directional lighting that highlights one object acts as a secondary light source for the surrounding room, through a light-reflecting mechanism. This system can also be combined with a uniform lighting system because it is useful to reduce the dull effect that may be caused by uniform lighting.

(iv) In a local lighting system, the light is concentrated on a specific object such as a workplace which requires a visual assignment to this system. This lighting system is very useful for facilitating tasks that require careful visualization, observing the shape and arrangement of objects that require light from a certain direction, completing general lighting that is blocked from reaching the special room you want to light, helping workers who are old or have reduced eyesight, and support visual tasks that were not originally planned for that room [8].

Minimum lighting levels and recommended colour rendering for different room functions are shown in Table 1. For classrooms, laboratories, and libraries, lighting must provide sufficient intensity, be evenly distributed, and not cause glare that could impair vision. The required classroom lighting intensity ranges from 120–250 lux [9]. Poor lighting can lead to drowsiness, lack of enthusiasm, and difficulty focusing, often caused by errors in planning light points in both new and reused buildings [10]. Lighting levels were measured with an LM-3000 lux meter mobile device at 75 cm above the floor, with averages taken from several points depending on the activity [11]. Observations were conducted in classrooms 7.021 and 7.009 on the 7th floor of UNIKOM's Smart Building, which are not directly exposed to sunlight during the day. Figure 1 shows the name of the room and the light points within the rooms. The process of measuring the lighting intensity in classroom 7.021 and studio room 7.009 is carried out by following the steps according to SNI 7062-2019 regulations regarding Measurement of Lighting Intensity in the workplace.

The instrument used for this measurement was a digital lux meter application, LM-3000, installed on an iPhone. This device functions by utilizing the phone's built-in light sensor, which has been calibrated to approximate standard lux meter readings. The tool was chosen for its portability, ease of use, and ability to record illumination values quickly at multiple points within the rooms. Although it is simpler compared to professional stand-alone lux meters, the LM-3000 provides reliable data for academic research purposes when measurements are conducted carefully and consistently.

Table 1. Recommended minimum exposure levels and colour retention.

Spaces Usage	Light Intensity (lux)	Colour Rendering	Adjective
Housing:			
Terrace	60	6	
Guest Room	120 – 250	1 or 2	
Dining Room	120 – 250	1 or 2	
Workspace	120 – 250	1	
Bedroom	120 – 250	1 or 2	
Bathroom	250	1 or 2	
Kitchen	250	1 or 2	
Garage	60	3 or 4	
Office:			
Director's Room	350	1 or 2	
Workspace	350	1 or 2	
Computer Room	350	1 or 2	
Meeting Room	300	1 or 2	
Drafting Room	750	1 or 2	
Archive	150	1 or 2	
Education:			
Classroom	250	1 or 2	
Library	300	1 or 2	
Laboratory	500	1	
Drafting Room	750	1	Plus Table lamp
Canteen	200	1	

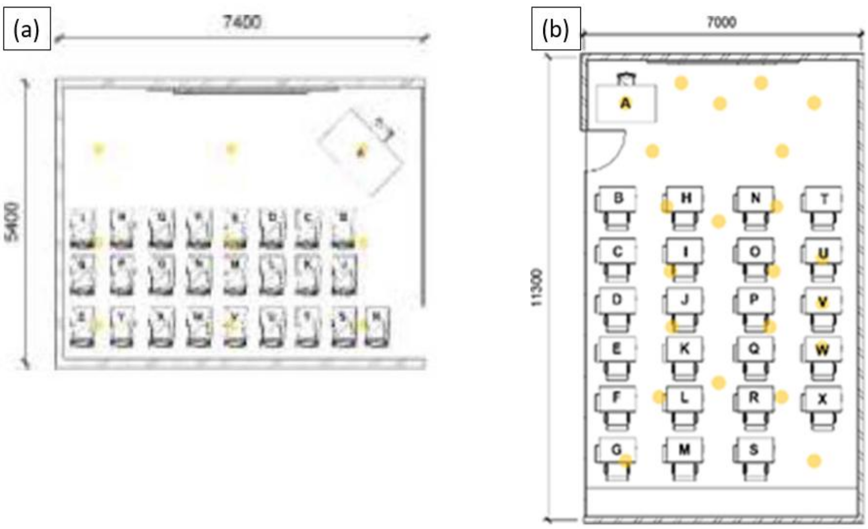

Fig. 1. Plan of measurement points for classroom (a) and studio (b).

From 26 measurement points in Classroom 7.021, the recorded results ranged from 80 lux on a student chair to 110 lux on a Lecturer desk. The average was 98.19 lux, whereas the SNI standard requires minimum of 250 lux.

Measurements in studio 7.009 showed a quite similar record. From 47 measurement points the recorded results ranged from 36 lux to 140 lux, both on a student drafting table. The average was 86.43 lux, whereas the SNI standard requires a minimum of 750 lux. Therefore, based on SNI 03-6575-2001, the results of measuring light intensity in classrooms and studio rooms do not meet the standards set. It is necessary to implement a design that integrates the artificial lighting system properly. The rearrangement of the light points must be based on the existing lighting distribution pattern in the room to increase or optimize the light intensity in the room. The lamp used should provide an even distribution of light and not create disturbing shadows. As well as specifically for drawing room categories such as studio rooms, it is necessary to add local lighting through the application of table lamps to increase the level of illumination according to the standards set by SNI-03-6575- 2001 [12].

Furthermore, a lux calculation is performed using the Revit plug-in software called Relux. This software is capable of calculating illumination based on standards. Thus, the results will state that a room meets luminance based on existing standards or vice versa. Relux measurement also corroborates the manual measurement using the lux meter, finding that the lighting in both classroom and studio does not meet the required standard.

Furthermore, a lighting modelling experiment was modelled using Blender software through simulation. The researchers evaluated the extent to which the lighting produced could reach the specified target, such as the level of brightness, light distribution, and emphasis on certain areas in classroom 7.021 and studio room 7.009. In the 3D model, researchers determined the position and type of points of light to create optimal illumination, as seen in Fig. 2.

Fig. 2. Enhanced lighting proposed by Relux: Classroom (a), (c); and studio (b), (d).

Moreover, there are alternative suggestions that were obtained by doing modeling to improve the lighting of classroom 7.021 and studio room 7.009 by:

(i) Using the same lamp point but changing the type of lamp and lamp wattage to 75 watts; or

(ii) Using the existing type of lamp (downlight) and adding another 25 watts extra lamp for each person.

These alternative suggestions are proposed to balance both energy efficiency and visual comfort. Increasing the lamp wattage to 75 watts while maintaining the same distribution point ensures a more uniform illumination without requiring major changes in the existing electrical layout [13]. On the other hand, adding extra 25-watt downlights per person is justified by the need to enhance task lighting, particularly in learning and studio activities where visual accuracy is critical [14-25]. Both approaches highlight a trade-off between installation cost and long-term energy consumption, yet they remain practical options to achieve the recommended illumination standards in classroom 7.021 and studio room 7.009 [26-28].

4. Conclusion

Lighting plays a fundamental role in supporting human activities, especially in learning environments. Evaluating and improving the lighting conditions in the architecture classroom and studio is needed, as improper lighting can cause lack of student concentration, visual fatigue, and create discomfort for users. The information can be obtained using a lux meter, compared to the SNI standard, developed through the Relux and Revit software, and also Blender for visualization. The process develops the existing lighting in both rooms which is insufficient according to the SNI Lighting standard to fully meet the recommended standards, with more uniform and sufficient illumination required. The implementation of the improved lighting design can enhance comfort, support better concentration, and serve as a practical reference for future similar classrooms and architecture studios.

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