

Lighting Intensity Analysis in The Biology Practicum Room at The Integrated Laboratory of UIN Sunan Ampel Surabaya

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Abstract: Lighting is one of the essential factors to support human work productivity. Therefore the use of lighting intensity has to be adjusted to the activities in a room. One room with a particular lighting intensity is a practicum room. The purpose of this study is to analyze the intensity of lighting especially in the Biology practicum room at the Integrated Laboratory of UIN Sunan Ampel Surabaya. The method of the research uses quantitative approach. The data are derived from the measurement and observation of the research object. The study was conducted on six Biology's practicum rooms located on the 3rd floor of Integrated Laboratory Building of UIN Sunan Ampel Surabaya which included practicum room for Biochemistry, Genetics, Ecology, Basic Biology A, Microbiology, and Basic Biology B. Primary data was obtained by measuring lighting in space using lux meter. The measured lighting focus is general lighting. The measurement data were then collected and analyzed by comparing them to SNI 03-6197-2000. The results show that all Biology's practicum rooms have windows that function as natural lighting from sunlight and are supported by artificial lighting sourced from lamps. In the measurements of six Biology's practicum rooms, there is a mismatch of lighting intensity to SNI 03-6197-2000 which includes a practicum of Ecology, Basic Biology A, and Microbiology. But the discrepancy is only at certain points. The suggestion is the need to replace the extinguished lamps at some measurement points so it can increase the intensity of the lighting in the room.

1 INTRODUCTION

Human activities are basically inseparable from lighting needs both day and night, both using natural lighting with sunlight and artificial lighting with lights. Lighting is one of the important factors that support human work productivity. According to Adi Putra and Madyono (2017) good lighting intensity is one factor to provide a good visual condition because lighting can affect seeing objects. If the intensity of the lighting is good enough, the object will be seen clearly and quickly in looking for it without causing significant errors.

According to Hendra et al (2013) that one of the important factors in increasing comfort in work is lighting that is suitable for the work needs. This is in line with the needs in the office work process which in fact lighting is the main supporting factor. While poor lighting can cause various types of eye complaints including eye fatigue, headaches, dry eyes, neck or shoulder complaints and stinging eyes.

Although lighting is an important factor, not all parties are able and willing to implement a good

lighting system. Based on the research conducted by Putri and Trifiananto (2018) the measurement of lighting intensity on the AKSI-Gresik campus was obtained 8 out of 10 rooms not in accordance with lighting needs. Of the 10 rooms at AKSI-Gresik A campus, only 2 rooms meet the SNI standard of 250 lux. Adi Putra and Madyono (2017) research from the results of lighting intensity measurements in each production area at PT. Lendis Cipta Media Jaya found that the production area received the highest lighting, which was 236 lux, but still not according to the standards set by the Decree of the Minister of Health of the Republic of Indonesia No.1405 / MENKES / SK / XI / 2002 which is 300 lux. Similarly, based on the results of data analysis obtained by Cahyantari et al (2016) in a study of lighting intensity analysis in the lecture hall of the physics building at the University of Jember showed that the average lighting intensity in the lecture hall had not met the standards that had been determined by SNI, namely 250 lux.

The use of lighting intensity in each room varies according to the designation of the room. Lighting intensity must be adjusted to the activities to be

carried out in a room. One room with a certain lighting intensity is a practicum room. The practicum room is a place that is used to conduct experimental and practical activities on a test that will be carried out. To find out and ensure the lighting intensity of a practicum room, it is necessary to analyze lighting sensitivity as one of the supporting work environments for occupational safety and health.

One of the practicum rooms with the most practitioners is a practicum room in the laboratory of an educational institution. Integrated laboratory is one of the laboratories in Sunan Ampel Surabaya State Islamic University. This laboratory consists of 3 floors. To support the implementation of practicum in this laboratory, an adequate lighting system is needed, both natural lighting and artificial lighting. Based on SNI 03-6197-2000 the lighting intensity for the function of the room as a laboratory in educational institutions is 500 Lux.

To determine the suitability of the level of lighting in the integrated laboratory of UIN Sunan Ampel Surabaya, especially in the biological practicum room, it is necessary to analyze the intensity of lighting in the room. This is an effort to improve safety and health in the laboratory. So the purpose of this research is to analyze the intensity of lighting especially in the Biology practicum room at the Integrated Laboratory of UIN Sunan Ampel Surabaya.

2 METHODS

This research method uses quantitative research methods. The data obtained are derived from measurement and observational results that are carried out by direct observation of the object of research without providing an intervention or treatment.

The study was conducted on 6 biological practicum rooms located on the 3rd floor of Integrated Laboratory Building of UIN Sunan Ampel Surabaya which included practicum room for Biochemistry, Genetics, Ecology, Basic Biology A, Microbiology, and Basic Biology B. Data collection was conducted in July 2018. Primary data obtained by measuring the lighting in the room using luxmeter. The measured lighting focus is general lighting. Measurements are carried out during the day as usual as practicum room use activities.

The lighting measurement work procedures are as follows (SNI 16-7062-2004):

1. Preparation
Luxmeter calibrated
2. Determination of measurement points

- a. General lighting: the point cuts the horizontal line the length and width of the room at any given distance as high as one meter from the floor.
 - b. The area of the room is between 10 square meters to 100 square meters: the intersection of the horizontal line the length and width of the room is at a distance of every 3 (three) meters.
3. Procedure for measurement
 - a. Turn on the calibrated luxmeter by opening the sensor cover.
 - b. Bring the device to the location of the predetermined measurement point
 - c. Read the measurement results on the monitor screen after waiting a while to get a stable number
 - d. Record the measurement results on the recording sheet
 - e. Turn off the luxmeter after the lighting intensity measurement is done

Lighting measurement data obtained from the research results were collected and analyzed by comparing them to SNI 03-6197-2000 (Energy Conservation in Lighting Systems).

3 RESULT AND DISCUSSION

Results

Biology practicum room is divided into 6 rooms, they are Biochemistry practicum room, Genetics, Ecology, Basic Biology A, Microbiology, and Basic Biology B. Extent of Biochemistry, Ecology, Basic Biology A, Microbiology and Basic Biology B practicum area of 86, 5 m². While the Genetics practicum room has an area of 56 m². Measurements are carried out during the day by lighting the room in the form of natural and artificial lighting.

	3,7 m	3,7 m	3,7 m
2,6 m	1	6	7
2,6 m	2	5	8
2,6 m	3	4	9

Figure 1. Mapping of lighting measurements of the Biochemistry practicum room

Table 1. Lighting measurement of Biochemistry practicum room

Measurement	Lighting (Lux)	Compliance with SNI 03-6197-2000 lighting standards
1	677	Corresponding
2	728	Corresponding
3	698	Corresponding
4	699	Corresponding
5	763	Corresponding
6	756	Corresponding
7	841	Corresponding
8	682	Corresponding
9	753	Corresponding
Average	733	Corresponding

Figure 1 is a mapping of lighting measurements in the Biochemistry practicum room which is divided into 9 points. In table 1 shows the results of lighting measurements with an average of 733 Lux, while the highest intensity is 841 Lux.

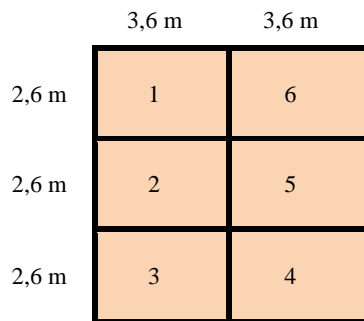


Figure 2. Mapping of lighting measurements of the Genetic practicum room

Table 2. Lighting measurement for Genetic practicum room

Measurement	Lighting (Lux)	Compliance with SNI 03-6197-2000 lighting standards
1	527	Corresponding
2	670	Corresponding
3	686	Corresponding
4	625	Corresponding
5	675	Corresponding
6	537	Corresponding
Average	620	Corresponding

Genetic practicum room has an area of 56 m2. In table 2 shows the results of lighting measurements

with an average of 620 Lux, while the highest intensity is 686 Lux.

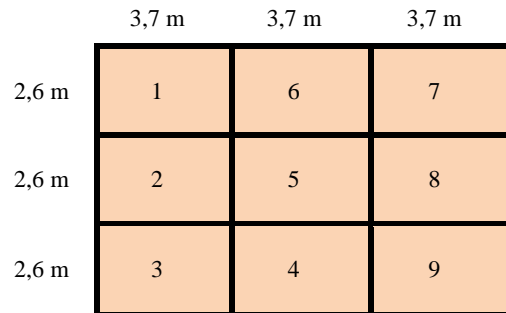


Figure 3. Mapping of lighting measurements of the Ecology practicum room

Table 3. Lighting measurements of Ecology practicum room

Measurement	Lighting (Lux)	Compliance with SNI 03-6197-2000 lighting standards
1	793	Corresponding
2	690	Corresponding
3	597	Corresponding
4	677	Corresponding
5	799	Corresponding
6	845	Corresponding
7	703	Corresponding
8	413	Not Corresponding
9	501	Corresponding
Average	669	Corresponding

In table 3 shows the results of lighting measurements with an average of 669 Lux, with the highest intensity is 845 Lux. While there is lighting that is not in accordance with the lighting standard.

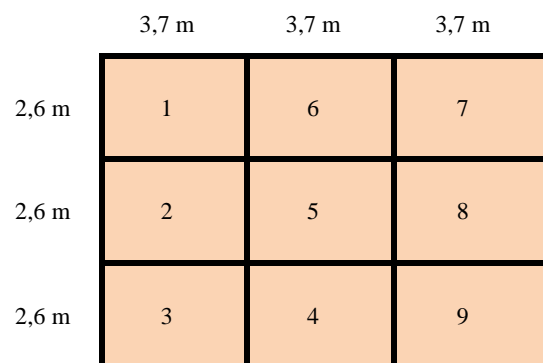


Figure 4. Mapping of lighting measurements of the Basic Biology A practicum room

Table 4. Lighting measurement of Basic Biology A practicum room

Measurement	Lighting (Lux)	Compliance with SNI 03-6197-2000 lighting standards
1	615	Corresponding
2	445	Not Corresponding
3	368	Not Corresponding
4	733	Corresponding
5	817	Corresponding
6	856	Corresponding
7	824	Corresponding
8	642	Corresponding
9	586	Corresponding
Average	654	Corresponding

From the measurement of lighting in table 4, shows the average lighting in the Basic Biology A practicum room is 654 Lux, with the highest intensity reaching 856 Lux. But there are 2 measurement results that are not in accordance with lighting standards.

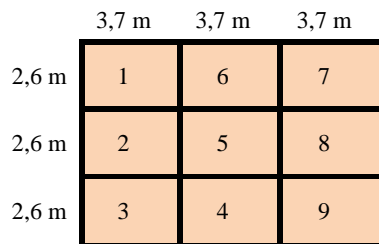


Figure 5. Mapping of lighting measurements of the Microbiology practicum room

Table 5. Lighting measurement of Microbiology practicum room

Measurement	Lighting (Lux)	Compliance with SNI 03-6197-2000 lighting standards
1	541	Corresponding
2	562	Corresponding
3	531	Corresponding
4	498	Not Corresponding
5	667	Corresponding
6	631	Corresponding
7	663	Corresponding
8	481	Not Corresponding
9	447	Not Corresponding
Average	558	Corresponding

In table 5 shows the results of lighting measurements of the Microbiology practicum room on an average of 558 Lux, with the highest intensity is 667 Lux. While there are 3 lighting that is not in accordance with the lighting standard.

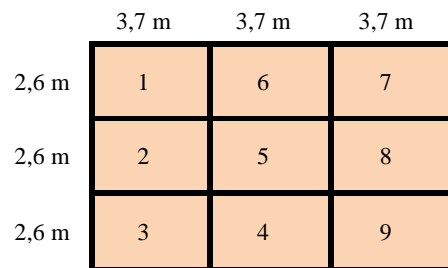


Figure 6. Mapping of lighting measurements of the Basic Biology B practicum room

Table 6. Lighting measurements of Basic Biology B practicum room

Measurement	Lighting (Lux)	Compliance with SNI 03-6197-2000 lighting standards
1	689	Corresponding
2	699	Corresponding
3	613	Corresponding
4	708	Corresponding
5	822	Corresponding
6	777	Corresponding
7	623	Corresponding
8	606	Corresponding
9	608	Corresponding
Average	683	Corresponding

The results of lighting measurements of the Basic Biology B practicum room in table 6 show an average of 683 Lux, with the highest intensity being 822 Lux.

Discussion

Biochemistry practicum room has an area of 86.5 m². From this area then mapped into 9 measurement points as shown in Figure 1. The results of lighting measurements in the Biochemistry practicum room as table 1 showed the highest lighting intensity reached 841 Lux, while the lowest intensity reached 677 Lux, while the average room lighting reached 733 Lux. From the measurement results at all points in accordance with the SNI 03-6197-2000 lighting standard, namely lighting intensity for the function of the room as a laboratory in educational institutions of

500 Lux. This lighting intensity match is supported by natural and artificial lighting in the room. The room consists of 3 glass windows that increase the intensity of natural lighting that comes in, besides that the room is equipped with 12 lights that act as artificial lighting.

The area of the Genetics practicum room is 56 m². In this Genetic space mapping is divided into 6 measurement points as shown in Figure 2. The results of lighting measurements in table 2 in this space show the highest lighting intensity reaches 686 Lux, while the lowest reaches 527 Lux, while the average room lighting reaches 620 Lux. When compared with SNI 03-6197-2000 lighting standards, the lighting intensity at all points is in accordance with these standards. The Genetics practice room has 2 windows and 9 lights. This is a support for room lighting.

The mapping of the Ecology practicum room with an area of 86.5 m² was mapped into 9 measurement points as shown in figure 3. Table 3 lighting measurement results show different lighting intensities. The highest lighting intensity is 845 Lux, while the lowest is 413 Lux, the average room lighting reaches 669 Lux. From this measurement it can be seen that there is one measurement point that is not in accordance with the SNI 03-6197-2000 lighting standard which is at the 8th point with 413 Lux. Whereas at other points are in accordance with the standards. The Ecology practicum room has 3 windows and is equipped with 12 lights. Non-conformity with the standard at point 8 is caused by the fact that there are lights that are extinguished, especially at that point, causing low intensity of lighting.

Basic Biology A practicum room has an area of 86.5 m². This room has 3 windows and 12 lights. The results of lighting measurements at 9 points in the Basic Biology A practicum room (figure 4) obtained results in table 4 with an average of 654 Lux, the highest lighting intensity reached 856 Lux, while the lowest reached 368 Lux. Of the 9 measurement points there are 2 measurement points that are not in accordance with the lighting standard SNI 03-6197-2000 that is at the second point of 445 Lux and the third point is 368 Lux. At the time of measurement there were 2 lights that were extinguished which were located around points 2 and 3. This affected the lighting intensity at the two points.

The Microbiology practicum room has an area of 86.5 m². Unlike other rooms, natural lighting is only obtained from one window. While the lights are the same as other rooms, there are 12 lights; From the microbiology practicum room area is mapped into 9 measurement points (figure 5). The results of lighting

intensity measurement (table 5) in this space can be seen that the highest lighting intensity reaches 667 Lux, the lowest lighting intensity is 447 Lux, and the average lighting is 558 Lux. From the measurement results at all points it can be seen that there are 3 measurement points that are not in accordance with the lighting standard SNI 03-6197-2000, namely the 4th point of 498 Lux, the 8th point is 481 Lux, and the 9th point is 447 Lux. This lighting intensity mismatch is caused by the lack of natural lighting. Natural lighting only comes from one window. While from 12 lights there is 1 lamp that goes out that is at point 4. This reduces the intensity of lighting needed.

The area of Basic Biology B practicum room is 86.5 m². Lighting measurements were carried out at 9 points as shown in Figure 6. In table 6 the results of the measurement of the Basic Biology B practicum room found the highest lighting intensity was 822 Lux, while the lowest was 606 Lux, and the average lighting reached 683 Lux. From the results of measurements at all points shows the intensity of lighting in accordance with SNI 03-6197-2000 namely lighting intensity for the function of the room as a laboratory in educational institutions of 500 Lux. The existence of natural and artificial lighting in this room supports lighting intensity. In this room there are 3 glass windows that strengthen the incoming natural lighting, besides that in the room there are 12 lights as artificial lighting.

Based on the results of the study that all biological practicum rooms consisting of 6 spaces (Biochemistry practicum room, Genetics, Ecology, Basic Biology A, Microbiology, and Basic Biology B) have windows that function as natural lighting ie from sunlight. According to Ginanjar (2012) natural lighting can be in the form of sunlight. Rahmania and Sugini (2013) natural lighting is light that comes from the sun. One of the natural lighting uses is to minimize the use of electrical energy.

Besides that, all biological practicum rooms are also supported by artificial lighting which is sourced from lamps. Juningtyastuti, et al (2012) artificial lighting is all forms of light whose source comes from man-made tools. Amin (2011) artificial lighting is the lighting produced by light sources other than natural light. This artificial lighting is very necessary in the room, especially the room with natural lighting intensity that is little or no.

Based on the results of measurements of 6 biological practicum rooms there is a mismatch of lighting intensity with SNI 03-6197-2000 namely lighting intensity for the function of the room as a laboratory in educational institutions of 500 Lux. Some of these practicum rooms include Ecology

practicum room, Basic Biology A, and Microbiology, there are incompatibilities with recommended standards, especially at certain points. This is too significant, considering the average lighting intensity in the room is in accordance with the required standards. However, lighting intensity that is not in accordance with standards can cause health problems, especially eye health. According to Devi, et al (2014) that lighting that does not meet standards is poor lighting. Poor lighting will interfere with vision, which in turn will reduce student concentration in the learning process. In addition, according to Suma'mur (2009) inadequate lighting can cause health problems for workers, one of which is eye fatigue. Eye fatigue arises as a result of intensive stress on eye functions such as the accommodation muscles that need careful observation or on the retina as contrast inaccuracies.

4 CONCLUSIONS

All biological practicum rooms which consist of 6 rooms (Biochemistry practicum room, Genetics, Ecology, Basic Biology A, Microbiology and Basic Biology B) have windows that function as inputs for natural lighting from sunlight and are supported by artificial lighting sourced from lamps.

From the results of measurements of 6 biological practicum rooms there is a mismatch of lighting intensity with SNI 03-6197-2000 (lighting intensity for the function of the room as a laboratory in educational institutions is 500 Lux), some of these practicum rooms are practicum in Ecology, Basic Biology A, and Microbiology there is a discrepancy with the recommended standards especially at certain points. This is mainly because there are lights that go out. Although this discrepancy is not significant, considering the average lighting intensity in the room is in accordance with the required standards, the lighting intensity that is not in accordance with the standards can cause health problems, especially eye health.

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