

## Efforts to Prevent Eye Fatigue Through Evaluation of Lighting Intensity (Illumination Level) in the Library at Muhammadiyah University Lamongan

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### ABSTRACT

The Muhammadiyah group has implemented community service programs (PKM) in collaboration with the Universitas Muhammadiyah Lamongan (UMLA) Library. In order to comply with SNI 03-6197-2000 regarding energy conservation in lighting systems, the PKM activity aims to measure and create a contour map of the lighting intensity level (also known as illumination level) in the UMLA library space, increase target partners' knowledge regarding lighting intensity (also known as illumination level) in the work space and its relationship to eye fatigue, and implement technology in the form of an IoT integrated room lighting system. The target partners will be fully involved in all activities, including FGD (First Measurement of Lighting Levels in Library Spaces), counseling regarding lighting intensity (Illumination Level) in work spaces and its relationship to eye fatigue, and the design and implementation of sensor and IoT based room lighting systems. The method for implementing community service activities is a participatory approach. The Muhammadiyah Lamongan University Library Institute, the community service partner, was able to accurately assess the illumination in the interpretation library room by means of a number of completed community service projects. We may conclude that the UMLA library's light intensity, which is  $\geq 300$  lux, satisfies the SNI criterion.

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## INTRODUCTION

Humans require lighting in order to recognize objects visually. The eyes, nerves, and brain's visual nerve center are the body parts that affect vision (Magero et al., 2023; Osemudiamen & Stanley, 2023). The primary portal for absorbing images from the external environment is the eye, as a visual instrument. Visual acuity is needed for over 90% of human labor activities, including learning activities (Chasanah & Widodo, 2023). Humans use their eyes to directly engage with their surroundings when performing tasks in order to see objects (Putra et al., 2021).

In a library, the majority of tasks primarily depend on visual perception. As a result, comfortable lighting in the library will make it easier for patrons to work there. The presence of a library at Muhammadiyah Lamongan University is a crucial tool for facilitating the application of the higher education chess dharma of Muhammadiyah-Aisyah. The average illumination intensity in the library is 300 lux (B SN, 2011), according to SNI 03-6197-2000 about energy saving (Putra et al., 2021) in lighting systems (Salehuddin & Latupeirissa, 2017).

The UMLA Library is the partner in this community service project. The UMLA library occupies 268 square meters. From 8:00 a.m. to 15.30 p.m., Monday through Friday, the UMLA library is open for business. It should be able to take use of natural lighting from dawn till dusk, depending on operating hours. The current state of affairs, however, indicates that the potential for natural lighting (Figures 1a and 1b) has not been optimally utilized, resulting in the use of artificial lighting as the primary source of light in the space during operating hours (Figure 1c). Conversely, the natural lighting that is obtained actually contributes to heat radiation and glare (Figure 1d). Other than that, there is no information available about the state of the illumination level or lighting intensity in the UMLA library. This situation suggests that the current building's lighting design is unable to offer visual comfort that satisfies library building standards.



**FIGURE 1.** UMLA Library Room (a), Space in the library (b), Use of artificial lighting during the day in the UMLA library room (c), Glare from natural lighting on one side of the library (d), Source: Author's, 2024

Given the possible issues partners may have with the state of the illumination level (Illumination Level) in the UMLA library space and the lack of knowledge among stakeholders in this case, the UMLA library management about the level of illumination (Illumination Level) in the space and its connection to eye fatigue as well as the unavailability of effective and efficient room lighting systems, both artificial and natural, In order to maximize the potential of the natural lighting that currently exists in the UMLA library building, it is necessary to assess the lighting intensity level (also known as the illumination level) in the space and counsel target partners regarding the lighting intensity (also known as the illumination level) in the work space and its relationship with eye fatigue. Additionally, science and technology must be applied. and offer suggestions on how to make the UMLA library cozy and compliant with accepted standards.

## METHOD

Target partners are fully involved in every activity as part of the participatory approach method used to implement community service activities (PKM) for this community service scheme within the company. Partners actively participate in all phases of this activity, including discussion, training, counselling, and mentoring (I Wayan Merta et al., 2022; Mayasari et al., 2020). The following is a detailed breakdown of the activity implementation steps.

1. Focus Group Discussion  
A preparatory Focus Group Discussion (FGD) between the service team and partners—specifically, the UMLA Library—was conducted prior to the implementation of PKM. This FGD activity aims to give service providers a way to communicate their ideas for the PKM program, with the expectation that they will get feedback to ensure the PKM operates well. Additionally, foster cooperation and mutual commitment to ensure that this PKM accomplishes its goals.
2. Initial Measurement of Lighting Levels in the Library Room  
Measurement and outreach activities are sequential program solutions held in this PKM program and are participated in by Partners with the following activity details:
  - Measurement of the lighting intensity level (Illumination Level) in the UMLA library room
  - Making a contour map of lighting intensity levels (Illumination Level) in the UMLA library room
  - Matching lighting intensity data with SNI 03-6197-2000 concerning Energy Conservation in Lighting Systems
  - Design of sensor and IoT based room lighting systems and lighting intensity contour maps
3. Counselling partners on how much light is enough for their workspace and how that relates to eye tiredness
4. Design and execution of lighting intensity contour maps and sensor- and Internet of Things-based room lighting systems



FIGURE 2. Flowchart of implementing community service. Source: Author's, 2024

## RESULT AND DISCUSSION

Together with partners from the Universitas Muhammadiyah Lamongan Library, the following community service projects have been completed in local settings:

1. Results of the Focus Group Discussion:

A preparatory Focus Group Discussion (FGD) between the service team and partners specifically, the UMLA Library was conducted prior to the implementation of PKM. This FGD activity aims to give service providers a way to communicate their ideas for the PKM program, with the expectation that they will get feedback to ensure the PKM operates well. Additionally, foster cooperation and mutual commitment to ensure that this PKM accomplishes its goals. The following are the findings from the FGD:

- The reading room of the Muhammadiyah Lamongan University Library has poor lighting because bookshelves obscure the lights, which makes them uncomfortable to look at, and there are several areas that are overly bright from sunlight streaming in through the windows and several areas that are generally dark from sunlight. usage of the library's space.
- Technology is needed at the Muhammadiyah Lamongan University Library to control room lighting and distribute it more evenly.
- It is necessary to socialize with library managers about the reading room's lighting configuration.



FIGURE 3. Focus group discussion, Source: Author's, 2024

2. Findings from measurements of the illumination in counselling rooms and libraries

Partners in this PKM program engage in outreach and measurement initiatives, which are organized in a sequential manner and include the following activity details:



(a)



(b)

FIGURE 4. UMLA Library Room (a), Space in the library (b), Source: Author's, 2024

- a. Measurement of lighting intensity levels (Illumination Level) in the UMLA library room. The data obtained are as follows:

**TABLE 1.** Light intensity measurements for zone 1 and zone 2, Source: Author's, 2024

Coordinates	Zone 1 Light Intensity (Lux)	Zone 2 Light Intensity (Lux)
1	397,6	260,6
2	370,7	298,6
3	494,2	302,3
4	104,1	342,8
5	368,2	391,7
6	244,4	369,3
7	218,7	464,7
8	312,6	538
9	482,5	715,3
10	431,4	1138
11	485,2	2484
12	738,8	4475
13	1073	423,4
14	386	501,1
15	266,9	667,8
16	607,2	1021
17	891,5	2249
18	1302	4716
19	2250	372,3
20	33,9	396,5
21	1297	610
22	329,9	863,7
23	537,6	998,6
24	703,5	384,1
25	898	285
26	1301	319,6
27	1905	382,9
28	940,1	438,6
29	276,4	435,5
30	451,4	325,2
31	618,6	234,7
32	626,9	264,5
33	776,9	280,2
34	841,3	359,6
35	575,5	274,5
36	165,5	238,9
37	178,1	219,4
38	181,7	217,8
39	205,6	232,2

Coordinates	Zone 1 Light Intensity (Lux)	Zone 2 Light Intensity (Lux)
40	185,1	228,7
41	159,6	196,3
42	154,3	165
43	95,8	186,5
44	190,3	187,2
45	209,6	168,8
46	221,5	163,3
47	241,4	150,6
48	230,9	109,6
49	196,9	198,4
50	92	207,8
51	181,7	241,6
52	214,8	262,4
53	232,9	198,2
54	211,5	126,8
55	213,6	201,3
56	203,2	219,8
57	130,4	272,1
58	251,5	489
59	318,1	530,9
60	349,5	159
61	397,5	153,3
62	312,2	225,5
63	222,1	282,8
64	190,2	570,1
65	235,2	831,4
66	388,5	220,1
67	381	167,4
68	756,9	206,1
69	3463	269,4
70	7880	407,1
71	180,2	269,5
72	314,3	181,4
73	227,7	319,7
74	490,5	151,7
75	1064	256,1
76	4075	140,5
77	4329	263,2
78	367,4	275,1

The quantity of energy received on a surface per unit area and time is known as light intensity, or illumination (Datangeji et al., 2019). The measuring duration can have an impact on light intensity measurements. Variations in the quantity of sunshine intensity can result from the daytime light intensity being less intense than that of the morning and evening (Tina Hernawati

Suryatman, 2021). In addition, the area of the room being used and the luxmeter's distance from the light source can affect the measurement's outcome. The intensity decreases with room width and the distance between the light source and the luxmeter (Kurniasih et al., 2019; Rezka Adi, 2019).

- b. Creating a contour map of the UMLA library room's illumination levels (lighting intensity levels)  
The light intensity values in the library are plotted using Surfer software based on the findings of the light intensity measurements, resulting in a data plot in zone 1 in Figure 1a and a data plot image in Figure 1b.

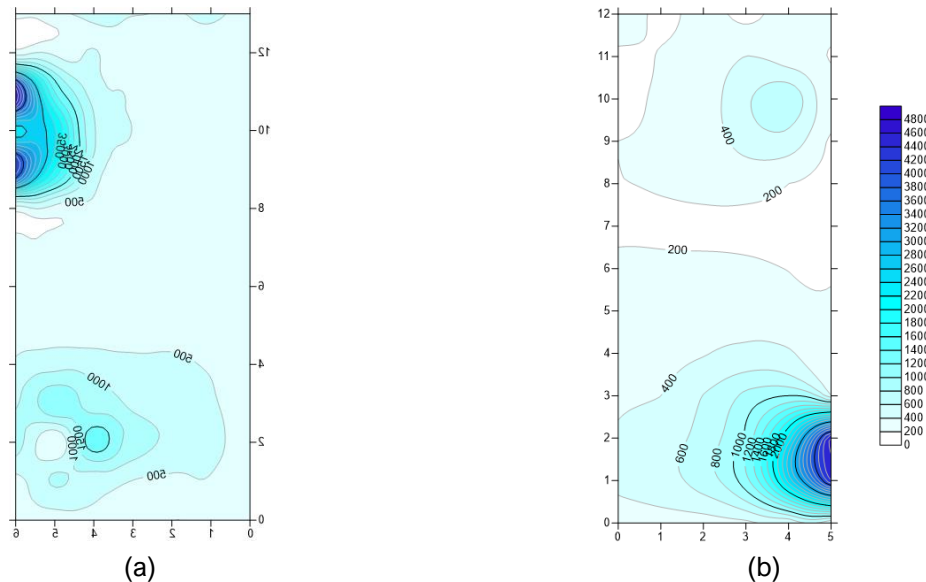


FIGURE 5. Zone 1 light intensity plot (a), Zone 2 light intensity plot (b), Source: Author's, 2024

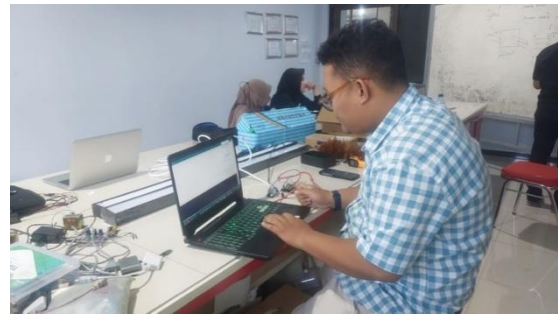
Data on light intensity values for 98 light intensity values in Zone 1 were produced based on the measurement findings shown in Table 1. These values ranged from 33.9 lux to 8,852 lux. In the meantime, 78 light intensity data values with a value range of 109.6 lux to 4,716 lux were recorded in zone 2, as shown in Table 1. In this investigation, single measurements were made, and the data collected differed more at each coordinate point.

Using Surfer software, data charting was created based on the findings of these measurements. Figures 5a and 5b display the findings of the zone 1 plot, where the intensity value is greater than or equal to  $\geq 500$  lux. Based on the layout of the library or research site, the plot indicates if there is light with an intensity of 500 lux or less next to the library window. The intensity value decreases with increasing blue colour. In the meantime, the blue-shaded locations in zone 2 begin at intensity values of less than 200 lux.

3. The design and assembly process for the appropriate technology tools—an integrated room lighting sensor system and Internet of Things-based lighting intensity contour maps—that will be implemented in libraries (PAMUNGKAS et al., 2015).



(a)



(b)

**FIGURE 6.** UMLA Library Room (a), Room contained in the library (b), Source: Author's, 2024

## CONCLUSION AND RECOMENDATION

The UMLA Library, the community service partner, was able to accurately assess the illumination in the interpretation library room by means of a number of completed community service projects. We may conclude that the UMLA library's light intensity, which is  $\geq 300$  lux, satisfies the SNI criterion. Zone 1 of the UMLA library has a light intensity value between 33.9 and 8,852 lux, whereas zone 2 has a light intensity value between 109.6 and 4,716 lux ranged. Bookshelves and poles are the source of intensity values below 300 lux, and uneven or continuous data collecting periods also have an impact on these values. As a result, the right technology must be utilized, specifically an integrated room lighting sensor system and Internet of Things-based lighting intensity contour maps.

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