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Architectural Studio Room Lighting Level in UNISA Yogyakarta Based on Software Dialux Evo 9.1

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ABSTRACT
The Studio Room for the Department of Architecture is an essential part of the learning process because the main competency for the Department of Architecture is Design. The design activities carried out by architectural students in the Studio Room are carried out for a long duration. So it requires a studio space that can facilitate these activities comfortably. One of the comfort factors needed is lighting, where design drawing activities require sufficient lighting. In this study, a simulation was carried out in the UNISA architectural studio room using the software dialux Evo 9.1 to determine the suitability of the lighting level in the studio room based on the requirements of SNI 03-6197-2011. The results of this study indicate that the UNISA Architecture studio room still does not meet the standards in terms of the level of lighting, so it requires lighting adjustments by adding and changing the type of artificial lighting.

Keywords: *Lighting, Daylight, Artificial, Architecture studio, Dialux evo.*

1. INTRODUCTION

The studio room is an essential room for the lecture process in the architecture department. Learning in the architecture department, which demands design competence for students, requires facilities to accommodate the activities of the design learning process for comfortable students. In the design process, students need a long time so that the comfort of the architectural studio space needs to be considered. With a relatively large number of credits, design courses usually require students to complete design projects in an architectural studio. Learning space is crucial to ensure the comfort of its occupants, especially for an architecture student who spends long hours in a studio to design, sketch, draw and build prototypes [1].

The use of a long time for these students requires a good level of comfort so that the design process can run smoothly and does not interfere with the comfort/health of students as studio room users. One aspect of comfort needed to support the design process is the aspect of room lighting. With suitable lighting levels, of course, it will not interfere with the eye health of students who use the studio room for a long time, sometimes even up to 24 hours.

According to SNI 03-6197-2011, Studio is an educational facility with the criteria of drawing a classroom that requires a lighting level of up to 750 lux [2]. This lighting level is needed so that students can optimally work on their design drawings. Lighting arrangements need to be considered to guarantee student comfort in the drawing and designing process. Increase interest and attention and can. A good lighting level can support learning activities, provide enthusiasm, and liven up a cheerful atmosphere [3]. The quality of lighting is related to the appropriate amount of light and light layout, such as lighting uniformity and lighting distribution [4]. The distribution of this lighting also needs to be considered so that its use is appropriate in every room with different functions in a building so that the energy generated from the use of lighting can be efficient because the energy used for lighting is one of large enough energies in a building [5].

The use of studio space for a long duration requires the suitability of the lighting level with the room's function to create comfort for studio room users. The architecture study program at UNISA Yogyakarta is an architecture study program that was only established in 2016, and as the number of students increases, it requires additional comfortable studio space. Decisions related to lighting design in buildings need to be planned from the start by the architect [6]. In meeting these needs, it is necessary to consider the existing studio space in planning a new studio space. So that is

expected to be a recommendation in the design of the next studio space.

2. PURPOSES

The aims of this research are as follows:

- Knowing the lighting level of the UNISA Yogyakarta architectural studio room
- Knowing the suitability of the lighting level of the Yogyakarta UNISA architectural studio room based on SNI 03-6197-2011
- Provide recommendations for appropriate lighting planning for the UNISA Yogyakarta Architecture studio room

3. RESEARCH METHODOLOGY

The research method used is a quantitative method by measuring the level of lighting in the studio room, followed by a simulation using the Dialux Evo 9.1 software. The measured lighting level is daylight and artificial lighting. Artificial lighting needs to be considered because it can increase the lighting level and shape the room's atmosphere [7]. Suppose the room has sufficient illuminance from natural lighting, energy consumption for artificial lighting [8]. The need for light in the room cannot be negotiated. These needs can be obtained through natural lighting and artificial lighting or both [9].

The results of the measurements will be compared with the standard of comfort of the studio room lighting as a drawing-room so that the level of suitability is known. The results of this analysis become a reference for simulating appropriate lighting for the UNISA Architecture studio room so that recommendations are obtained according to SNI 03-6197-2011 standards (Figure 1).

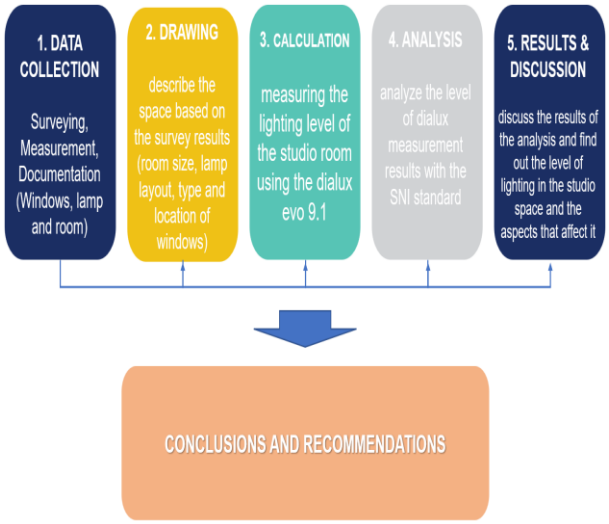


Figure 1 Research method flow (Source: Author, 2021).

4. RESULTS AND DISCUSSION

The studio room that became the research location is in the Architecture Studio Building B 4th floor UNISA Yogyakarta (Figure 2). Studio 1 has four openings on the east side, measuring 0.6m x 2.4m, and studio 2 has two openings on the south side, measuring 0.8m x 1.8m. Each Studio uses Philips TMS022 2x36W 2xTL-D36W/840 HF Standard +GMS022 R lamps in terms of artificial lighting. The number of lamps in studio 1 is eight, and studio 2 is six [8].

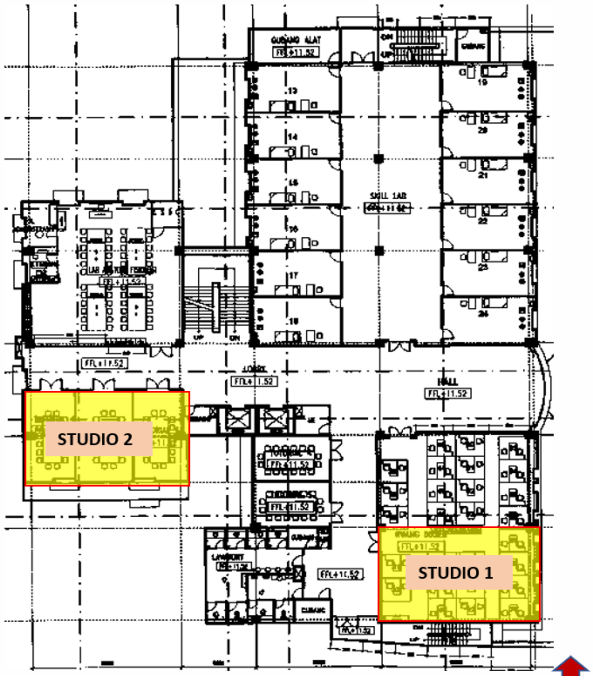


Figure 2 Location of the UNISA architectural studio room (Source: Author Analysis, 2021).

The results of measurements using the software dialux Evo 9.1 on the level of lighting in studio 1 and studio 2 UNISA Architecture obtained the following details (Figure 3-8):

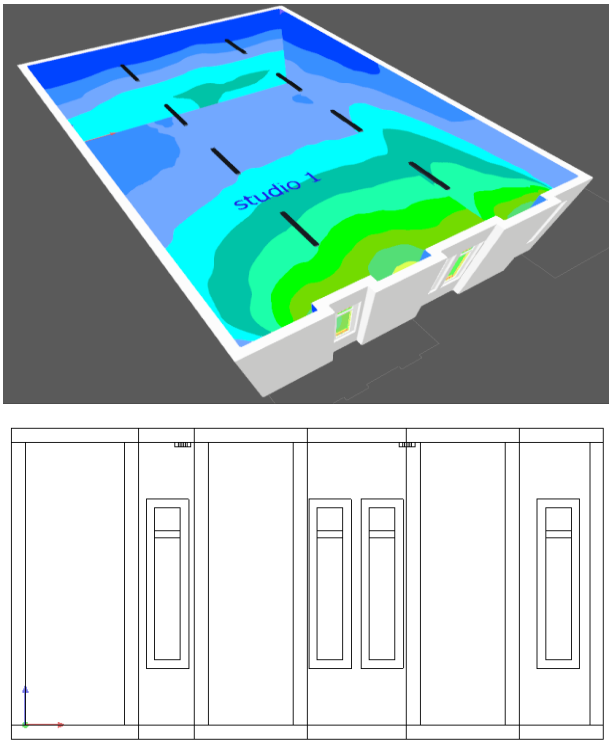


Figure 3 Lighting layout architecture studio room 1 (Source: Author analysis, 2021).

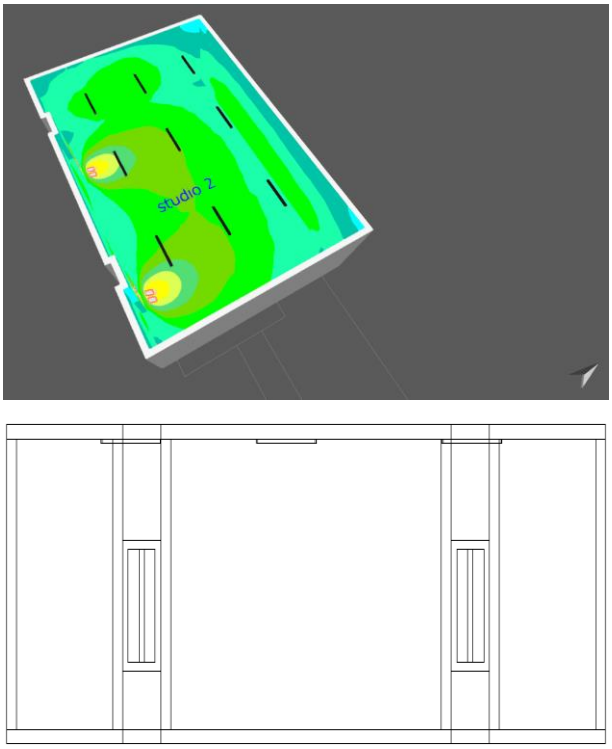
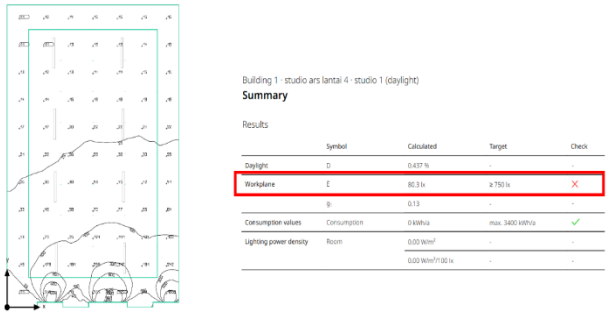


Figure 6 Lighting layout architecture studio room 2 (Source: Author analysis, 2021).



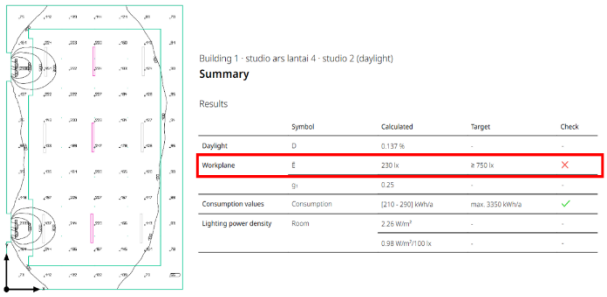
Building 1 · studio ars lantai 4 · studio 1 (daylight)

Summary

Results

	Symbol	Calculated	Target	Check
Daylight	D	0.437 %	-	-
Workplane	E	80.3 lx	≥ 750 lx	✗
	gr	0.13	-	-
Consumption values	Consumption	0 kWh/a	max. 3400 kWh/a	✓
Lighting power density	Room	0.00 W/m²	-	-
		0.00 W/m²/100 lx	-	-

Figure 4 Simulation results of daylight measurements for architectural studio room 1 (Source: Author analysis, 2021).



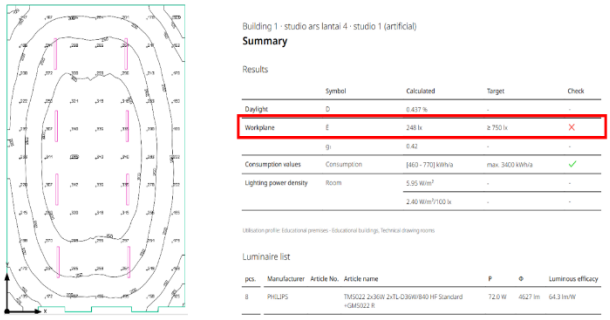
Building 1 · studio ars lantai 4 · studio 2 (daylight)

Summary

Results

	Symbol	Calculated	Target	Check
Daylight	D	0.137 %	-	-
Workplane	E	230 lx	≥ 750 lx	✗
	gr	0.25	-	-
Consumption values	Consumption	[210 - 290] kWh/a	max. 3350 kWh/a	✓
Lighting power density	Room	2.26 W/m²	-	-
		0.98 W/m²/100 lx	-	-

Figure 7 Simulation results of daylight measurements for architectural studio room 2 (Source: Author analysis, 2021).



Building 1 · studio ars lantai 4 · studio 1 (artificial)

Summary

Results

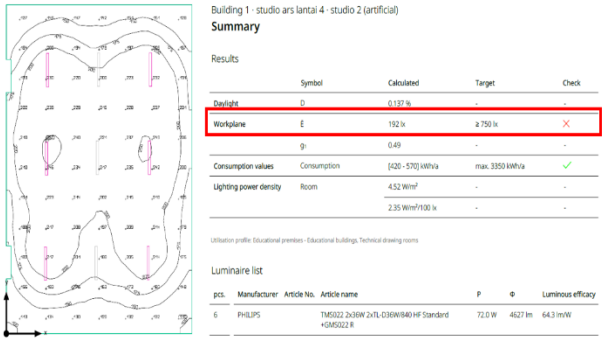
	Symbol	Calculated	Target	Check
Daylight	D	0.437 %	-	-
Workplane	E	248 lx	≥ 750 lx	✗
	gr	0.42	-	-
Consumption values	Consumption	[460 - 770] kWh/a	max. 3400 kWh/a	✓
Lighting power density	Room	5.95 W/m²	-	-
		2.40 W/m²/100 lx	-	-

Utilisation profile: Educational premises - Educational buildings, Technical drawing rooms

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
8	PHILIPS		TMS022 2x36W 2xTL-D36W/840 HF Standard +GMS022 R	72.0 W	4627 lm	64.3 lm/W

Figure 5 Simulation results of measurement of artificial lighting for architectural studio room 1 (Source: Author analysis, 2021).



Building 1 · studio ars lantai 4 · studio 2 (artificial)

Summary

Results

	Symbol	Calculated	Target	Check
Daylight	D	0.137 %	-	-
Workplane	E	192 lx	≥ 750 lx	✗
	gr	0.49	-	-
Consumption values	Consumption	[420 - 570] kWh/a	max. 3350 kWh/a	✓
Lighting power density	Room	4.52 W/m²	-	-
		2.35 W/m²/100 lx	-	-

Utilisation profile: Educational premises - Educational buildings, Technical drawing rooms

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
6	PHILIPS		TMS022 2x36W 2xTL-D36W/840 HF Standard +GMS022 R	72.0 W	4627 lm	64.3 lm/W

Figure 8 Simulation results of measurement of artificial lighting for architectural studio room 2 (Source: Author analysis, 2021).

Table 1. Simulation result of UNISA architectural studio room lighting level

Room	Artificial lighting	Daylight	SNI 03-6197-2011	Suitable
Studio 1	248 lux	80,3 lux	750 lux	×
Studio 2	192 lux	230 lux	750 lux	×

Based on the analysis of the lighting level on its suitability as a drawing-room in SNI 03-6197-2011 (Table 1), it is known that the level of lighting in the architectural Studio of UNISA Yogyakarta is still not appropriate (below the standard recommended by SNI).

It is necessary to plan lighting to increase lighting in the architectural studio space to a minimum of 750 lux. Efforts can be made to increase the number of windows or increase the number of lamps/light illuminations to obtain a comfortable level of lighting for the studio room.

The following is an alternative lighting design that is suitable for the standard of light comfort for the UNISA Architecture studio room (Figure 9,10):

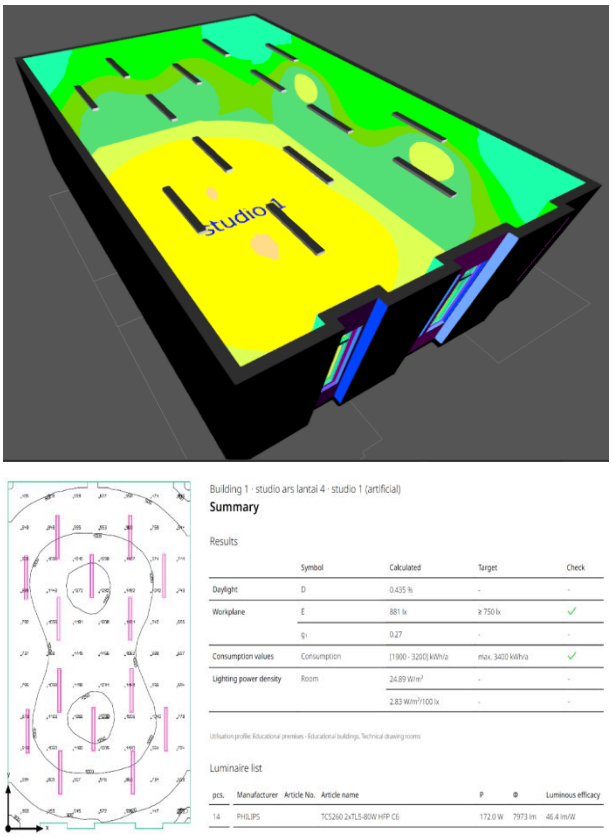


Figure 9 Architectural studio room lighting design recommendations 1 (Source: Author analysis, 2021).

The recommended design is to change the type of lamp and increase the number to follow the standards required as a studio room with architectural drawing activities, which is 750 Lux. In-studio 1, it is recommended to use 14 Philips TCS260 2xTL5-80W HFP C6 lamps.

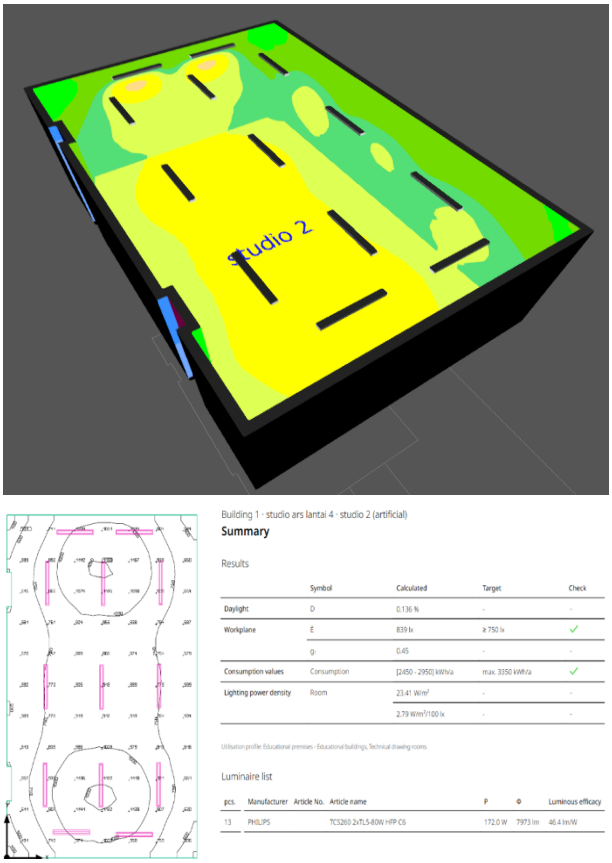


Figure 10 Architectural studio room lighting design recommendations 2 (Source: Author analysis, 2021).

The recommended design for studio 2 is to use 12 Philips TCS260 2xTL5-80W HFP C6 lamps. The two simulated alternatives using the Dialux Evo 9.1 software produce lighting levels according to the SNI 03-6197-2011 standard, which is above 750 Lux.

5. CONCLUSION

Based on the simulation results on the lighting level in the UNISA Architecture Studio Room using the Dialux Evo 9.1 software, the following conclusions are obtained:

- The lighting level of the Architecture studio room UNISA Yogyakarta is below 750 lux and is still not following the standard lighting level for the function of the drawing-room according to SNI 03-6197-2011
- It is necessary to increase the number of lamps in each Studio and replace the lamp with the TCS260 2xTL5-80W HFP C6 type to produce lighting levels above 750 lux.

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