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Analysis of the effect of light intensity on eye fatigue complaints and concentration in teaching and learning in the lecture room

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Abstract

The intensity of light in the classroom has an important role in creating comfortable teaching and learning. This research aims to analyze the effect of light intensity on the comfort of the teaching and learning process in lecture room. The research was carried out using a survey method and measuring the light intensity on students' study tables. The measurement results show that the light intensity ranges from 109 lux to 212 lux, which is below the minimum standard for light intensity for study rooms according to SNI 03-6197:2000, namely 250 lux. A total of 43 students were respondents in this research, with comfort data measured using a Likert scale questionnaire. Data analysis shows that low light intensity has an impact on learning concentration levels that are less than optimal. As many as 58% of respondents stated that light intensity affected study concentration. Meanwhile, 67% of respondents stated that low light intensity causes eye fatigue. This study recommends increasing light intensity in classrooms to support more effective teaching and learning processes.

Keywords: Light Intensity; Eye Fatigue; Study Concentration

1. Introduction

Lighting is a crucial element in an educational environment. Optimal lighting not only provides visual comfort but also supports cognitive and emotional performance during the teaching and learning process. Adequate lighting intensity in the classroom can help students concentrate, understand learning materials, and prevent eyestrain. Previous research has shown that poor lighting quality can decrease productivity, increase fatigue, and exacerbate physical conditions such as headaches or eye strain. In Indonesia, classroom lighting standards are regulated by SNI 03-6197:2000, which stipulates that the minimum light intensity for classrooms is 250 lux. However, many classrooms, especially in universities, do not meet this standard due to building design factors, the age of the lighting installation, or a lack of regular maintenance.

The learning process in this lecture hall involves theory and practice, requiring high levels of concentration, both in the classroom and in the laboratory. However, comfortable learning is often hampered by the lack of adequate lighting in classrooms. This study aims to measure lighting levels in lecture halls and analyze their impact on eye fatigue and concentration during teaching and learning. By combining quantitative data from light intensity measurements and comfort questionnaires, this study is expected to provide recommendations for improving the quality of the learning environment.

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2. Literature review

Research into the relationship between lighting intensity and complaints of eye fatigue in students in the classroom shows that there is a significant relationship between lighting intensity and complaints of eye fatigue, which can affect students' concentration in learning [1]. Lighting is a crucial element in supporting an effective teaching and learning process. Adequate light intensity not only improves visual comfort but also impacts student concentration and productivity. Conversely, suboptimal lighting can cause eye fatigue, reduce attention levels, and even impact overall learning outcomes [2] Lighting plays a key role in creating a comfortable learning environment. Adequate lighting allows students to read, write, and view the whiteboard without eye strain. Classrooms with optimal lighting show up to a 20% increase in student academic performance compared to classrooms with inadequate lighting. Some solutions to increase light intensity in classrooms include installing additional lighting, using high-efficiency lamps, and rearranging the room layout to maximize natural light [3]

Research at SMP Negeri 6 Surakarta shows that low natural lighting intensity in classrooms affects students' learning comfort [4]. A similar thing was found in a study conducted at SMA Negeri 1 Airmadidi, where poor lighting increased students' fatigue levels during the learning process [5]. The results of the study found that inadequate lighting intensity can cause eye fatigue, which in turn can affect concentration and work productivity. Meanwhile, research conducted[6] analyzed the effect of lighting intensity on eye fatigue in students in the classroom. The results showed that inadequate lighting can cause eye fatigue in students, which in turn can reduce their learning concentration. Reference [7] in its research results shows that lighting in classrooms affects students' cognitive abilities, especially in terms of concentration and visual comfort. Meanwhile, research results[8] state that adequate natural lighting, combined with ventilation, has a positive impact on student learning outcomes. Research conducted by [9], states that the learning atmosphere, including good lighting, plays a significant role in students' academic achievement. Meanwhile, [10], concludes that lighting that meets standards helps reduce visual fatigue and increases students' attention.Improved lighting in classrooms can reduce eye fatigue by 38.53% and student learning boredom by 67.43%. Therefore, it is recommended that classroom users pay attention to the lighting intensity in the classroom to avoid eye fatigue and learning boredom[11]. SNI 03-6197:2000 stipulates that the minimum lighting intensity for classrooms is 250 lux. This standard is designed to ensure comfort and safety for classroom users. However, many classrooms in Indonesia, including those in higher education institutions, do not meet this standard.

3. Research method

Figure 1 Digital Luxmeter

This study used a quantitative descriptive method with a survey approach and light intensity measurements. The light intensity was measured using only artificial light, without any natural light components. This is because the room where the study was conducted was designed for artificial lighting. The study subjects were 43 students attending lectures in the same classroom. Data were collected using a questionnaire to measure levels of eye fatigue and student concentration.

Measurements were made using a lux meter at several points on the students' study tables to obtain an overview of the distribution of light intensity. Light intensity measurements were carried out in classroom E, during the teaching and learning process. Measurements were carried out using a lux meter mini light meter type UT383, UNI-T brand. Measurements were carried out in several places, namely: at the front center of the class, the front right side, the front left side, the middle left side, the middle right side, the back left side, the back right side, the back center side and on the whiteboard. The measuring instrument was placed on the students' study tables where students usually put books and stationery or laptops. Measurements of light intensity on the outside were carried out at a distance of 1 meter from the classroom wall. The questionnaire was compiled based on a 5-point Likert scale, covering aspects of eye fatigue complaints and concentration ability, regarding lighting in the classroom.

4. Discussion

The measurement results show that the light intensity in classroom E was carried out at 9 different points. The measurement results showed the numbers 113 lux, 137 lux, 140 lux, 142 lux, 146 lux, 175 lux, 176 lux, 182 lux, 212 lux and on the blackboard, 2 measurements were carried out and the light intensity values were 110 lux and 109 lux. This value, when adjusted to the national standard on artificial lighting in buildings for teaching and learning purposes, is below the minimum standard.

Figure 2 Measurement of light intensity in the front left corner of the lecture room

Figure 3 Measurement of light intensity in the front right corner of the lecture room

Figure 4 Measurement of light intensity in the rear right corner of the lecture hall

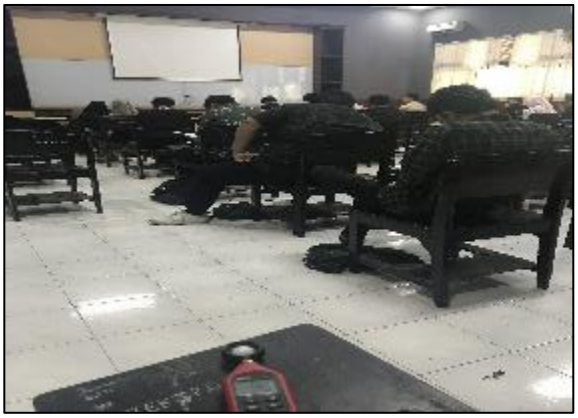

Figure 5 Measurement of light intensity in the left rear corner of the lecture hall

The measurements showed that the lowest values were on the whiteboard side, at 109 lux and 110 lux. The highest values were on the front left side of the whiteboard, at 212 lux. Values on the other sides ranged from 137 lux to 182 lux. Measurements were taken at several points within the classroom by placing a luxmeter directly above the students' desks. This was done because the desks are where students store their study materials, such as notebooks, laptops, and other items.

Based on the questionnaire results, the majority of students felt uncomfortable with the current lighting conditions. Twenty-nine respondents (67.4%) stated that inadequate lighting caused eye fatigue, while 25 respondents (58.13%) stated that it affected concentration during the teaching and learning process. Table 1, which discusses light intensity standards based on room function, shows the standard values used as a reference when designing artificial lighting installations in buildings. These values serve as a benchmark to ensure that users experience no complaints during prolonged and frequent use. These standards are established by the Indonesian National Standards Agency. Therefore, they should serve as a reference for building designers when determining artificial lighting systems in buildings.

Table 1 Standard light intensity based on room function (SNI 03-6197-2000)

Room / Activity Function	**Minimum Illuminance (Lux)**	**Description**
General circulation areas (corridors, halls)	100 lux	Basic visibility for movement
Storage rooms (low activity)	150 lux	For simple object identification
Offices – general work	300 lux	For reading, writing, and typical office tasks

Offices – detailed work (technical drawing, precision tasks)	500 lux	For tasks requiring higher visual accuracy
Classrooms	250 lux	Suitable for reading and learning activities
Libraries – reading areas	300 lux	For comfortable reading and study
Libraries – stack areas	150 lux	For book searching and shelving
Retail stores – general areas	300 lux	Provides adequate visibility for shoppers
Retail stores – display areas	500 lux	Highlights products and improves visual appeal
Meeting rooms	300 lux	Suitable for presentations and discussions
Laboratories	500 lux	Required for scientific and analytical work

To gather responses from respondents, a questionnaire was distributed to 43 people. The results showed that 63% of respondents reported experiencing eye fatigue during prolonged reading and writing activities or during the teaching and learning process. Meanwhile, 42% of respondents reported experiencing a loss of concentration due to low lighting intensity in the classroom.

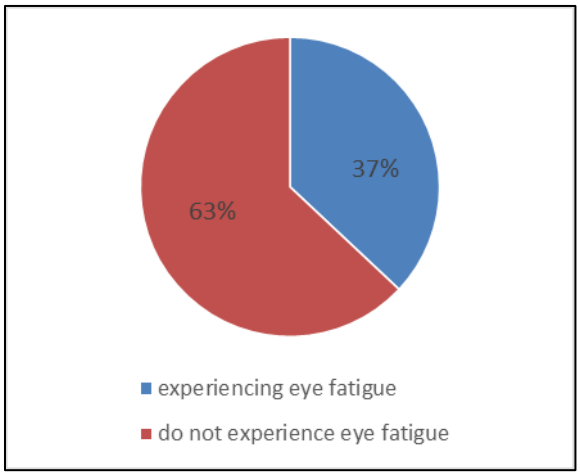

Figure 6 The effect of light intensity on eye fatigue

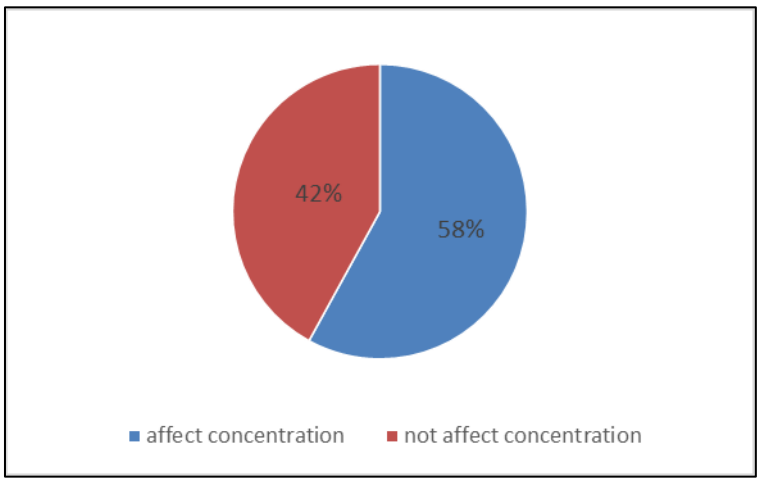

Figure 7 The effect of light intensity on learning concentration

These results are in line with the results of research conducted [12] showing that optimal lighting can improve learning comfort and productivity. Therefore, it is important to consider increasing the light intensity in the classroom so that students can feel more comfortable and focused on learning. In his book, Rea provides references regarding the basic principles of lighting, lighting applications, and technical standards for lighting in various types of spaces, including classrooms, offices, and other public spaces. This book is used by lighting professionals to design effective and efficient lighting systems according to the specific needs of a space. Rea also explains various important concepts in lighting, including light intensity, light distribution, color temperature, and how lighting affects visual comfort and human performance. Values of lighting intensity for various types of spaces, including classrooms.

Lighting for classrooms, for example, is recommended to be in the range of 300-500 lux to support comfortable learning for students. This value is somewhat different from that generally used in Indonesia, which uses a standard[13] where the value for classrooms is set at above 250 lux. Research by Ref [13] discusses the influence of lighting on health and well-being. In their research, they state that proper lighting can improve visual comfort and help prevent health problems such as eye strain and fatigue. This research emphasizes the importance of lighting that is not only bright enough, but also considers the even distribution of light throughout the room, as well as the appropriate color temperature and light intensity to support daily activities, including learning activities in the classroom. According to [14], poor or inadequate lighting can cause disturbances in visual comfort, which then affects concentration, productivity, and even emotional well-being. Therefore, this research supports the importance of carefully regulating lighting in learning environments, such as in classrooms, to create better conditions for students. This research is an important reference in the study of the influence of lighting on learning comfort, because it highlights the relationship between lighting quality with visual performance and comfort which in turn can affect the effectiveness of the learning process.

The results of this study indicate that light intensity is still below the national standard. Inadequate lighting can reduce learning efficiency and decrease the quality of classroom interactions. Increasing light intensity to meet standards is expected to improve visual comfort and support a more conducive learning environment.

5. Conclusion

Based on the results of the analysis above, the following conclusions can be drawn:

The light intensity in the classroom where the study was conducted did not meet the recommended minimum standards. This negatively impacted the comfort of teaching and learning. Sixty-seven percent of respondents reported experiencing eye fatigue, while 33% stated that light intensity had no effect on eye fatigue. Fifty-eight percent of respondents reported experiencing decreased concentration due to the lack of light intensity in the classroom, while 42% of respondents stated that they did not experience any loss of concentration due to substandard light intensity.

To improve the quality of learning, it is recommended to evaluate and improve the lighting system in the classroom, for example by installing additional lights or rearranging the position of the light source.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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