

# The Act of Lighting in The Library on User Preference of Space (Case Study: Central Library of Institut Teknologi Bandung)

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## Abstract

The importance of both natural and artificial lighting to support human activities has been widely studied but the impact on the human's preference in the library to support their productivity has not been exclusively researched. This research aims to investigate library users' preference for space in the library of Institut Teknologi Bandung related to the existing lighting. Productivity is closely linked to human's physical and psychological state while both aspects are affected by age, experience, educational background, and many more. We assessed and figured out the impact of lighting towards the user preference of space and used 66 magister students of Institut Teknologi Bandung to evaluate the responses. The statistic results suggested that respondents came to the library after 1 p.m. until 4 p.m. for various reasons and one of them was the lighting. The lighting was also a factor that helped them to read and study better in the library. However, other factors also contributed to their preference for space, including the thermal, atmosphere, and furniture varieties, consecutively. This study proves the positive effect of lighting in user preference of space towards their productivity to read and study better.

**Keywords:** *library; lighting; productivity.*

## 1 Introduction

Enoch et al. stated that sight is the most important sense for humans [1]. On the other hand, light is essential to support human sight. The link of sight and light has been researched since the ancient Greek era. Pythagoras (500BC) suggested that sight is caused by visual light that came from the eye and other bright objects. That statement was later disputed by Ibn al-Haytham in his book named "Book of Optics (1038). Instead of describing the sight as an active light produced by the eye, Ibn al-Haytham interpreted sight as a passive movement of light bounced by an object. According to Azeemi et al. [2], light holds important roles to support human life since it maintains the human's biological rhythm to work, move, and sleep. Essentially speaking, light acts to illuminate the environment so human eyes could see objects in it. However, the presence of light also affects how humans behave in an environment.

In many studies, natural lighting has been touted as the best yet most comfortable lighting type for public space especially for buildings that operate from morning until afternoon. Nevertheless, natural lighting is uncontrollable (cloudy, foggy, glare, etc.). While the motivation to study

could be affected by the lighting, it highly depends on one's condition, experience, and other background matters. The Magister students will be the respondents of this study since they have a more homogenous educational background and motivations to go to the library. While the convenience level in a university library can be touted closely affect the perception forming, it can increase the reading motivation on the users or vice versa.

The library of Institut Teknologi Bandung is a four-story building. The first floor is the administrative and service area as well as the lobby which users come and go through the door in this floor. The second floor is an area where users can find various collections and references about science while the third floor is a room for journals, dictionaries, encyclopedia, magazines, and other collections that widely used in students' papers. The fourth floor is where users can find public collections that were granted by various sources. The second and third floors use bright colors on its sofas and bookcases. Those differentiate these floors with the rest.

## 2 Literature Review

### 2.1 Lighting

As stated by Merlindriati, lighting is one of the many factors that should be met to create a safe yet comfortable environment and this aspect is closely related to human productivity [3]. Besides helping to see the objects in the surrounding environment, lighting is a factor that affected how human interprets the environment itself. Lighting is divided into two major types: natural lighting and artificial lighting, which both affect mood, health, comfortability, and alertness as stated by Boyce in [4], Van Bommel in [5], and Cajochen in [6]. Natural lighting is touted to be the most preferred type of lighting for various reasons but this lighting type has a few limitations especially when it comes to the weather.

Artificial lighting comes to accommodate human activities from time to time. According to Merlindriati in [3], artificial lighting functions include to create visual comfort and improve performance, to provide a stable yet even lighting system without glare and shadow, to bring illumination without increasing the room temperature, and to generate an environment that supports the users to perform visual tasks easily and precisely.

### 2.2 Lighting in Libraries

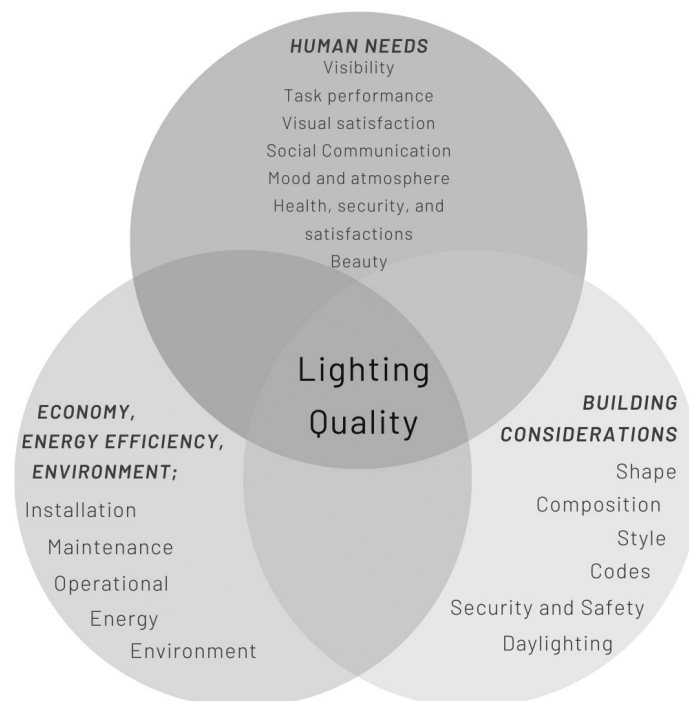
Swaris and Perera stated that lighting in libraries aims to provide adequate illumination and creates familiar space for the readers, especially aspects that related to perception and visual comfort [7]. Reading still becomes the main function of libraries even though today's libraries have adjusted the functions with the digital era, reading would still be one of the main activities in the building. Good lighting quality would make the users feel encouraged and connected with the materials to read. National Standardization Agency has advised to provide 300 lux for libraries in general. However, Steany suggested four main things that lighting could cover inside the building such as, (1) casual seeing, (2) concentrated seeing, (3) looking but not seeing, and (4) looking to find something [8]

### 2.3 Productivity

Generally speaking, productivity is a concept that shows a close relation between the result and the time needed to produce a certain product according to Revianto in [9], Smith and Wekeley in [10], and Daryanto in [11]. Fajri also stated that productivity is linked to motivations. In some theories, motivations are an inclination that shows in an individual to act in a certain way to get a certain result [12]. It makes individual's reading productivity gets affected by his motivation, according to Pujiono [13]. The higher an individual gets motivated and committed, the higher his productivity although various factors such as the reading material, the font type, and others may also give contributions. Individual's perception towards the surroundings highly affect his working productivity, according to Leaman [14]. Geng et al. suggested that the optimum productivity could be gained by being in a neutral room temperature. The higher level of thermal satisfaction would lead to higher productivity [15]. It seems like productivity is closely linked to any activity that involves productions, inputs, and outputs in the process. This research is focusing on the productivity of the library's users while they are inside the building and doing their regular activities related to reading, studying, and visual tasks under the existing lighting.

### 2.4 Lighting and Productivity

Kralikova stated that there were various possibilities to create a proper visual condition even if the static lighting was limited to cover the minimum standard [16]. Kralikova also explained factors that influenced the lighting quality and two of them were coming from the user (human).



**Figure 1.** Lighting Quality (Kralikova, 2015)

According to Gligor, lighting must be designed to ensure the proper visual condition for humans as the user so the tasks can be done efficiently, safely, dan conveniently. Lighting is like a chain that connects physical and psychological factors that build humans, which in the end could affect the performance and productivity of them [17]. Meanwhile, Boyce concluded that the effects of lighting in the human's productivity was still ambiguous. The obstacle to finding the connection between lighting and productivity could not be secluded from other factors that simultaneously affect human performance [18].

Concluding the explanations above, studies about lighting affects human performance to work have been widely done previously. However, the lighting intensity is not the only factor that may affect the whole lighting condition. Poor lighting quality, practically, could decrease human productivity.

### 3 Method of Study

We were using a descriptive qualitative approach to define the study. A qualitative approach is excellent for performing exploratory research, especially to retrieve data about human attitude. According to Maxwell, qualitative methods are suitable to explore and observe the field when the data is about human behavior [19]. The data-gathering process also involved questionnaires distribution. It was used for clustering respondents' tendencies when it comes to choosing the spot in the library and the reason behind their decision. Although quantitative data is also part of the process, the result is analyzed through a qualitative approach. Other than that, we also compare findings in the field with the latest yet relevant theories for the sake of data reliability.

The observation was performed to narrow the respondents since library users came from various backgrounds (bachelor students, magister students, doctoral students, lecturers, professors, staff, and so on) which lead to data heterogeneity. Later, we decided to choose magister students as respondents. Magister students have a higher possibility to come to the library for studying, reading, borrowing books, and other activities that might be relevant for this research compared to bachelor students and doctoral students. Besides, magister students have the shortest time to finish their study compared to the other two groups which might make them have a higher urgency as well. Meanwhile, bachelor students as the majority of the students in the university mostly came to the library to spend their free time before running to the next classes. Some of them also played games and used the Wi-Fi without performing activities like reading books, studying, or borrowing books like magister students.

We also distributed questionnaires that consist of several questions. Respondents were asked to (1) describe their social backgrounds such as age and gender, (2) describe the visitation characteristics such as the frequency, time, duration, and the purpose, (3) assess several testimonies related to the current lighting in the library, (4) affirm other factors that affect the visual satisfaction and perception during their time in the library. The testimonies were weighed by using the Likert scale that consists of five numbers to measure the rating – 1 rating expresses 'extremely disagree' and 5 rating expresses 'extremely agree'. The questionnaires were distributed and answered by 66 magister students of ITB.

## 4 Results and Discussion

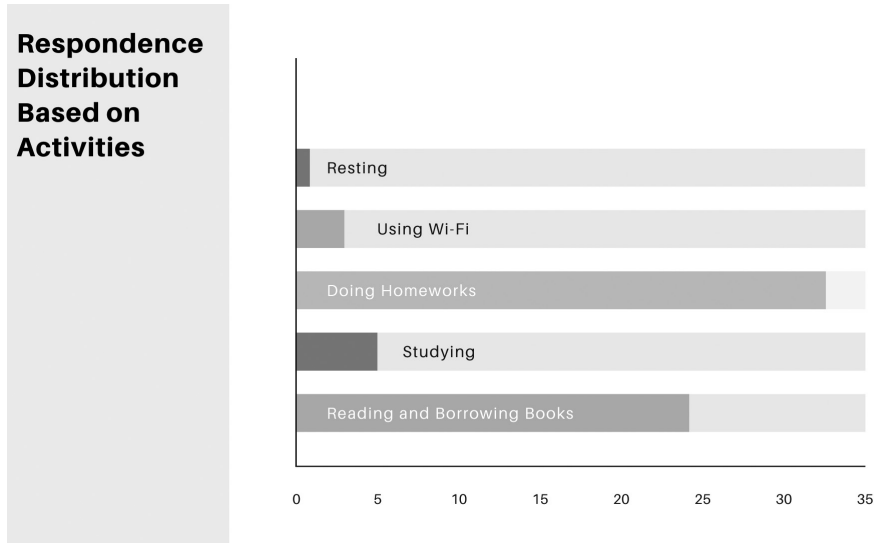


Figure 2. Respondent distribution based on activities (Sources: Questionnaires calculation)

Figure 2 shows the distributions of respondents based on their activities. 50% (33 respondents) of them came to the library for ‘doing homework’ and ‘reading and/ borrowing books’ consecutively. Although a few of them did other activities the number was not as many as the two activities.

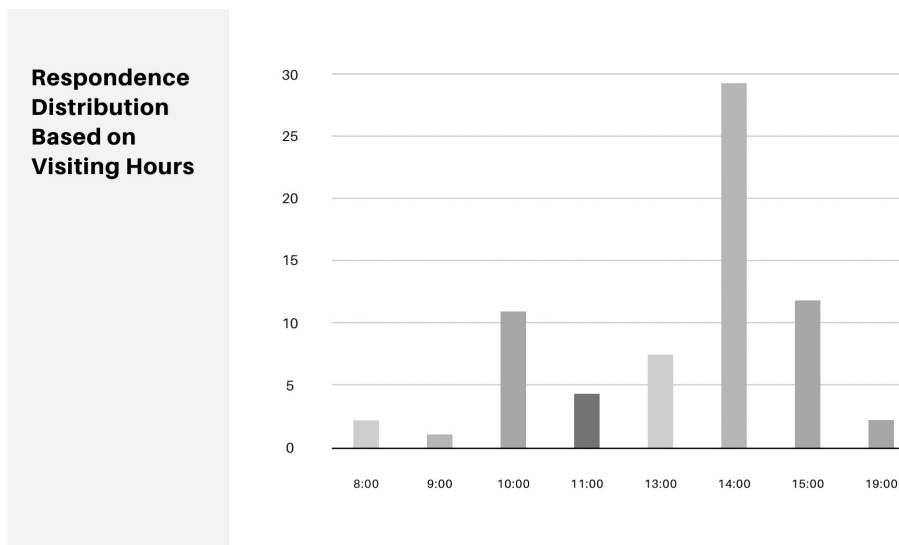


Figure 3. Respondent distribution based on visiting hours (Source: Questionnaire calculation)

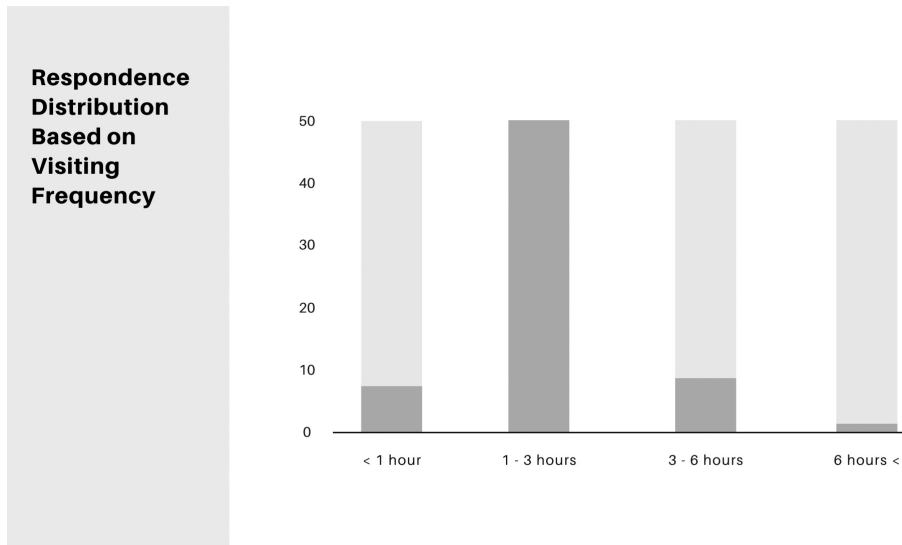


Figure 4. Respondent distribution based on visiting frequency per visitation (Source: Questionnaire calculation)

According to Figure 3 and Figure 4, most respondents came to the library at 1 p.m. and 2 p.m. Although several individuals visited the library at different hours, the number was not as many as those who came at 1 p.m. and 2 p.m. Other than that, 75.75% (50 respondents) spent 1 to 3 hours per visitation.

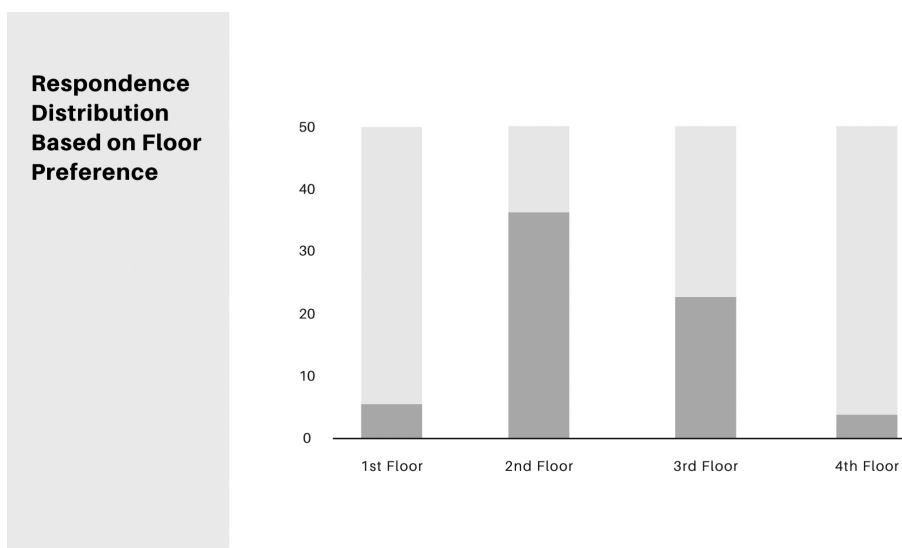


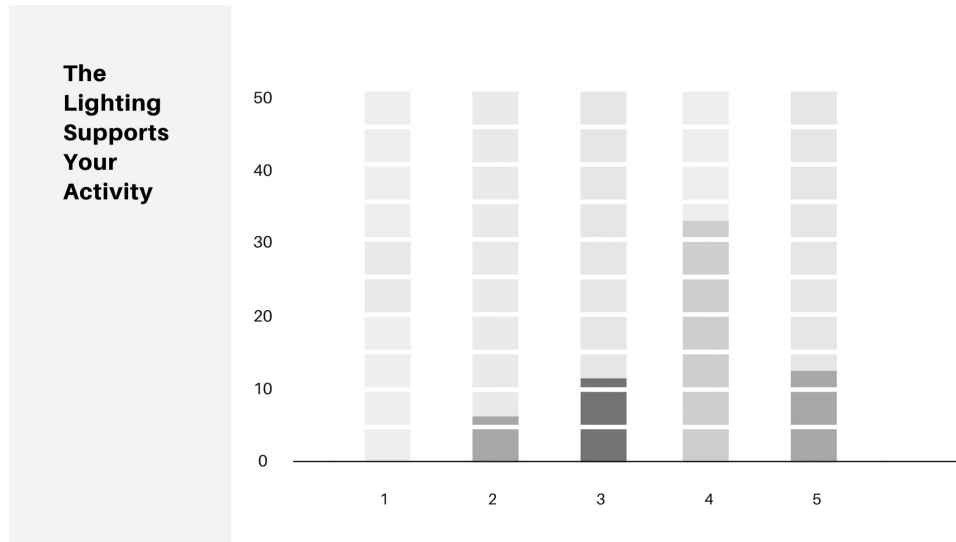
Figure 5. Respondent distribution based on the floor preference (Source: Questionnaire calculation)

Figure 5 suggested that 54.54% (36 respondents) prefer the second floor while 31.81% (21 respondents) chose the third floor. Meanwhile, the fourth floor did not seem very popular among the respondents.

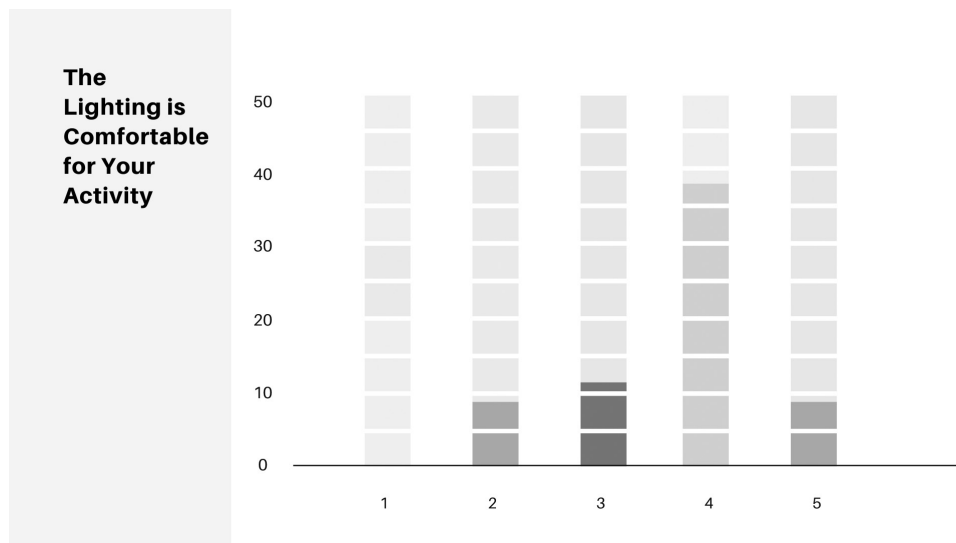
According to the assessment above, we concluded that our assumption about magister students only came to read books and study was proven. Other than that, the time chosen by respondents to visit the library was 1 p.m. and 2 p.m. As stated in the National Standard of Indonesia, the strongest sunlight exposure for natural lighting can be found between 8 a.m. and 4 p.m. [20]. Also, respondents prefer to spend their time on the second floor and third floor, where the sunlight

had extravagant access to the reading area.

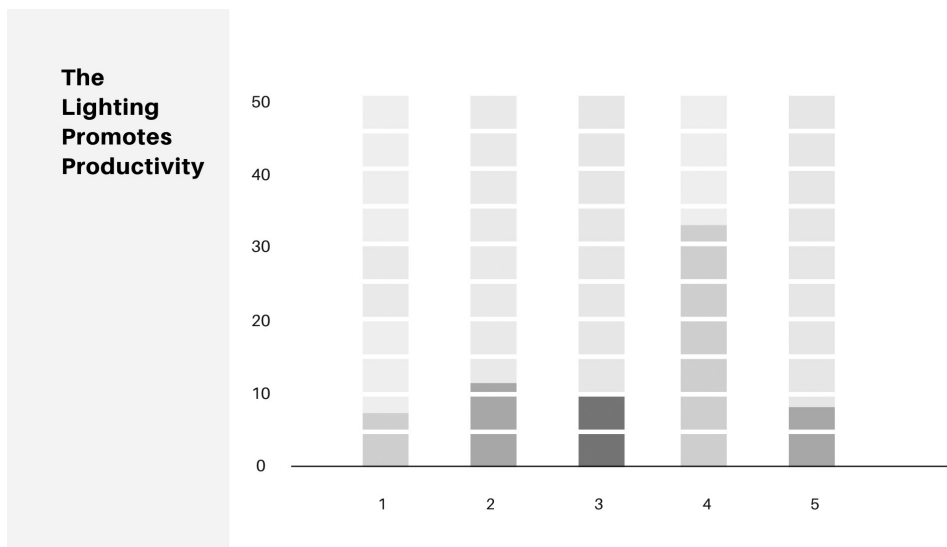
We also measured respondents' reactions towards several items of statements written on the questionnaires. We asked the respondents to rate each statement from 1 to 5 (strongly disagree to strongly agree).



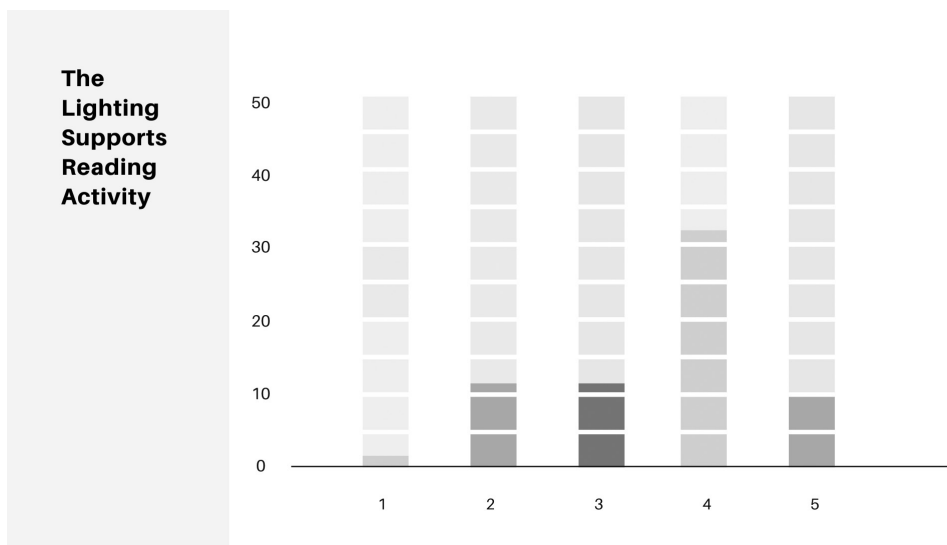
**Figure 6.** 37 of 66 respondents agree that the lighting supports their activities and 5 of 66 respondents strongly agree to the statement. Meanwhile, 6 of 66 respondents disagree with the statement and 11 of respondents chose to be neutral.



**Figure 7.** 38 of 66 respondents agree and 8 of 66 respondents strongly agree towards the statement. However, 9 of 66 respondents disagree that the lighting makes them comfortable to perform their activities while the rest (11 respondents) went with 'neutral'.

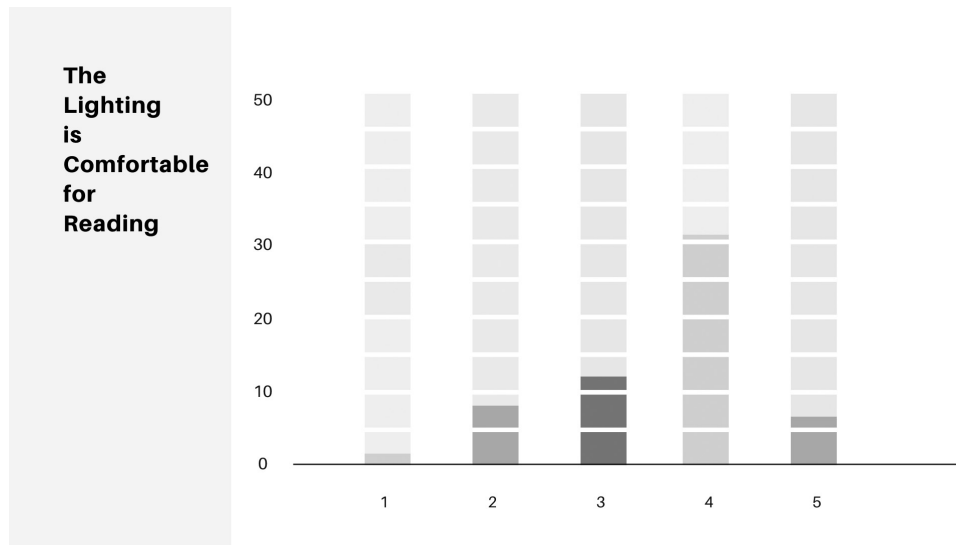


**Figure 8.** Based on the activity they performed in the library, 34 of 66 respondents agree and 8 of 66 respondents strongly agree towards the statement. Meanwhile, 11 of 66 respondents disagree and 3 of 66 strongly disagree that the lighting in the library promoted productivity. The rest went with 'neutral'.

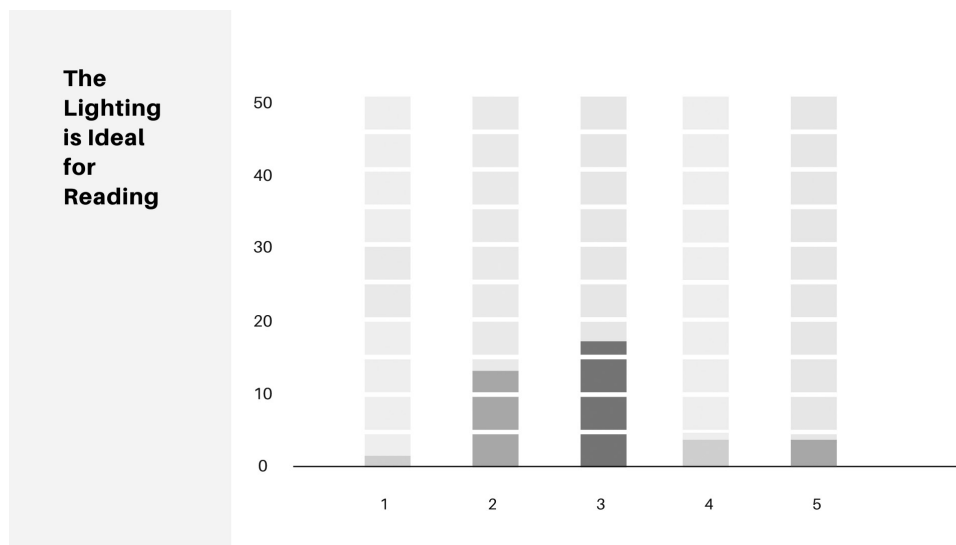


**Figure 9.** When we address to reading activity, the answers were more varied. 10 of 66 respondents strongly agree and 32 of 66 respondents agree that lighting supported their reading activity. On the other hand, 11 of 66 respondents chose to disagree and 2 of 66 respondents strongly disagree towards the statement. The rest went with 'neutral'.

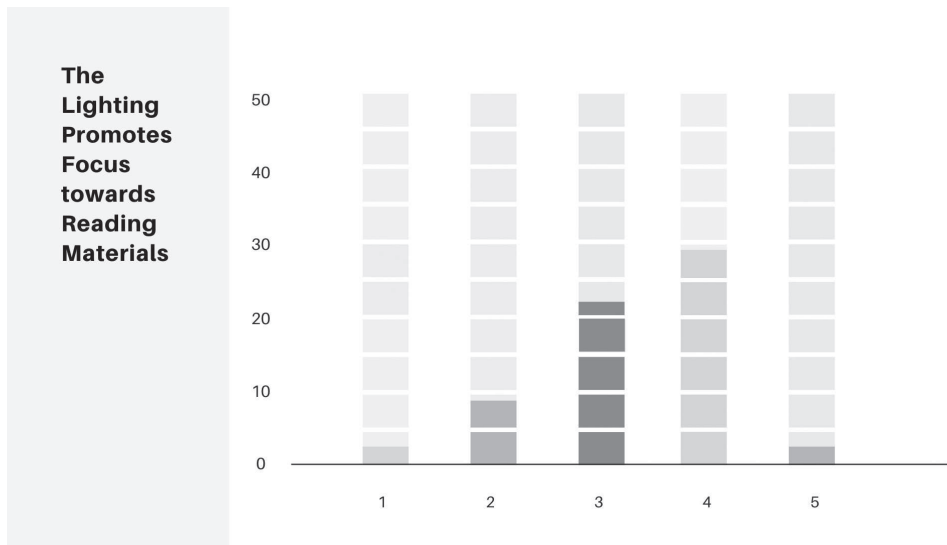




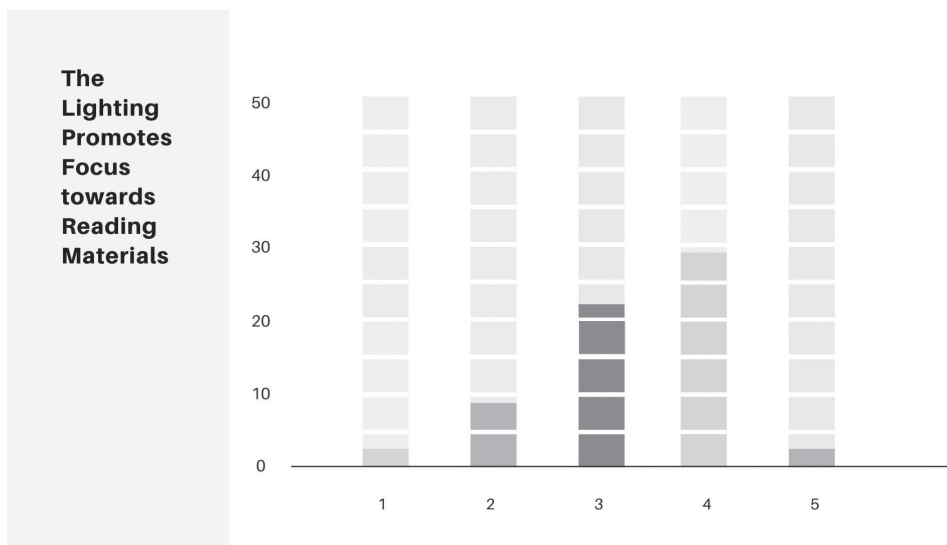
**Figure 10.** 7 of 66 respondents strongly agree and 36 of 66 respondents agree towards the statement. However, 9 out of 66 respondents disagree and 2 of 66 respondents strongly disagree that the lighting was comfortable for reading. The rest (12 respondents) chose 'neutral'.



**Figure 11.** When asked about whether the lighting is ideal for reading or not, 4 of 66 respondents strongly disagree and 4 of 55 respondents agree towards the statement. 12 of 66 respondents disagree and 2 of 66 respondents strongly disagree if the lighting was ideal for reading. Nonetheless, 17 of 66 respondents chose to be neutral.



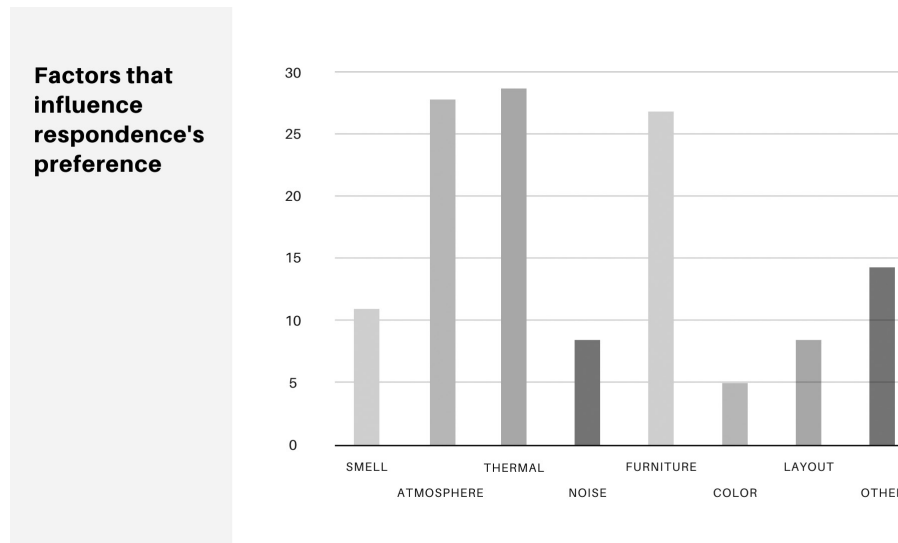
**Figure 12.** 3 of 66 respondents strongly agree and 29 of 66 agree that the lighting promoted focus towards the reading material. In contrary, 9 of 66 respondents disagree and 3 of 66 respondents strongly disagree towards the statement. 22 of 66 respondents, on the other hand, went with 'neutral'.



**Figure 13.** When asked about eye fatigue, 2 of 66 respondents strongly agree and 16 of 66 respondents agree towards the statement that the lighting provoked eye fatigue. However, 24 of 66 respondents and 3 of 66 respondents strongly disagree towards the statement. 18 of 66 respondents remained neutral.

We tried to map how magister students described the lighting in the library and how it affected their activities and preference when it comes to choosing the spot in the building. According to the questionnaires, we concluded that the lighting in the library seemed to be 'fine' for the respondents. The lighting simply supported their activity, comfortable enough to perform their activity, promoted productivity, supported productivity, and comfortable enough for reading. However, it could not be concluded that the lighting was ideal for reading considering 14 respondents gave a negative response and 8 respondents gave positive feedback while the rest remained neutral. Several respondents opened up that the lighting in the afternoon (after 1 p.m.) was okay for paper-based activity while they turned into laptop-based activities after 5 p.m. We

also asked about other factors that might influence them to choose the spot to do their activities in the library.



**Figure 14.** Distribution of factors that influence respondents' preference

Based on the chart above, respondents considered thermal or temperature as the strongest another factor that influenced them to choose the spot in the library. It was followed by atmosphere and furniture options. The result was in accordance with a study conducted by Mohanty and Carr [21] that furniture could impact the preference of users' library along with noise and color.

## 5 Conclusion

The central library of Institut Teknologi Bandung is a “public” building designed for the university’s community that opens from 8 a.m. to 9 p.m. We found that respondents would come at 1 p.m. and after 1 p.m. for various reasons. The lighting was supporting paper-based activities until 5 p.m. because it got dimmer as it was getting late. It might be caused by the big windows installed in several spots in the library. According to observation, several users tended to fill the space and seating options near the windows instead of choosing other options located in the middle of the room. Other than that, the most popular spots were located on the second and third floor where the bright colors dominated the scene. Since the majority of respondents might use the library for several purposes like reading and borrowing books, studying, and doing homework, there were a few of them who used the building for other purposes like sleeping and using the Wi-Fi. Further research is highly needed for a clearer image of how the lighting in the library contributes to the productivity of the users related to reading and studying.

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