

THE INFLUENCES OF ROOM DESIGN BY VIRTUE OF TEMPERATURE LEVEL AND ILLUMINATION TOWARDS WORK'S PRODUCTIVITY

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Abstract

The activity of learning was an activity that need concentrated and pleasure which influences by design supported of room. In this activity, either student or teacher oftentimes felt exhausted rapidly, not comfortable and did not concentrated because of room temperature and illumination with less prerequisite. To solve this problem, so that we're doing remedical by room according to it's sized and adding the local illumination in activity room. These research were test on a room which consist of 35 people with designed with different temperature and illumination level are the same. Data analysis approach literature and design experiments to evaluate the productivity of learning. These research result showed that temperature level and illumination were had to be remedical according to light intensity level and temperature degree. In this case we can conclude that designed of activity room which concentrated of temperature and local illumination can increase the productivity on learning activity (work).

Keywords: *designed, temperature, illumination, work productivity.*

1. INTRODUCTION

The activity of learning was an activity that need concentrated and pleasure which influences by design supported of room. Design room was influences by many physical work environment factors including temperature and illumination.

Good illumination is the illumination which allow workers to see the object clearly, quickly, and without unnecessary effort. Good temperature is the temperature can provide a sense of comfort and produce an increase job performance.

This raised a question whether the temperature and lighting in the work environment affect the performance of the workers, if the temperature is hot and bright lighting can reduce the productivity of the labor, and temperature is too cold and bright lighting can also reduce the productivity of labor, and how to set temperature and room temperature and room lighting fitting work in order to increase worker productivity.

Because of these condition, the purpose of this research is how to define and design a space that provides comfort, temperature and concentration on

the level of intensity of illumination in order to improve learning productivity.

2. RESEARCH METHODOLOGY

The steps undertaken in this study consisted of several stages. The initial step is to identify problems that occur. The issue raised is how to define and design a room based on the temperature and intensity of illumination to productivity of learning (work).

The second stage is to conduct a study of literature through journals, books, modules, and other sources that can support research to obtain information about the level of temperature and light intensity based on similar types of activities that affect the productivity of labor.

The next stage is the design of experiments based on temperature and illumination level results from the study of literature. Experimental design to the 35 people treated the subject. Each treatment group was given a different room designs that is second comparison group interaction with the

lighting the same temperature. Once entered into the experiment room, subjects were left for 15 minutes to adapt to the situation room. After 15 minutes, the subject of learning activity will run for 200 minutes to see the power point slides with the subject matter using the tools and mencatatnya dilembar infocus provided. After that, judging by the amount of the output of each subject were compared with the output value analysis based on the design of different rooms. The results of the analysis step is performed as the result of research by using the approach to the study of literature and experimental design. Analysis was conducted to evaluate the level of temperature and light intensity as a design space in terms of comfort, concentration and fatigue that affect work's productivity.

3. RESEARCH AND RESEARCH'S RESULT

3.1 Illumination

According to Ahmadi (2009) "*Intensitas penerangan adalah banyaknya cahaya yang tiba pada satu luas permukaan*".

Illumination by the source is divided into three, namely (Cok Gd Rai, 2006):

- a. *penerangan alami yaitu penerangan yang berasal dari cahaya matahari,*
- b. *penerangan buatan yaitu penerangan yang berasal dari lampu,*
- c. *penerangan alami dan buatan yaitu penggabungan antara penerangan alami dari sinar matahari dengan lampu/penerangan buatan.*

Based on the above literature study, it was found that the source of illumination that is used to design the room is a source of artificial lighting where illumination comes from light.

According to Ching (1996), there are three methods of illumination, namely:

- a. *penerangan umum atau baur menerangi ruangan secara merata dan umumnya terasa baur.*
- b. *Penerangan lokal atau penerangan untuk kegunaan khusus, menerangi sebagian ruang dengan sumber cahaya biasanya dipasang dekat dengan permukaan yang diterangi.*
- c. *penerangan aksen adalah bentuk dari pencahayaan lokal yang berfungsi menyinari suatu tempat atau aktivitas tertentu atau obyek seni atau koleksi berharga lainnya.*

Based on the above methods of lighting, then lighting a suitable method for studying the activity room design method or diffuse general lighting, where lighting is evenly illuminate any room.

According to Prabu (2009), mentions that there are 5 in a room lighting system, namely:

- a. *direct lighting*

Pada sistem ini 90%-100% cahaya diarahkan secara langsung ke benda yang perlu diterangi.

- b. *semi direct lighting*

Pada sistem ini 60%-90% cahaya diarahkan langsung pada benda yang perlu diterangi, sedangkan sisanya dipantulkan ke langit-langit dan dinding.

- c. *general diffus lighting*

Pada sistem ini setengah cahaya 40%-60% diarahkan pada benda yang perlu disinari, sedangkan sisanya dipantulkan ke langit-langit dan dinding.

- d. *semi indirect lighting*

Pada sistem ini 60%-90% cahaya diarahkan ke langit-langit dan dinding bagian atas, sedangkan sisanya diarahkan ke bagian bawah.

- e. *Indirect lighting*

Pada sistem ini 90%-100% cahaya diarahkan ke langit-langit dan dinding bagian atas kemudian dipantulkan untuk menerangi seluruh ruangan.

Based on the above lighting system, the indirect lighting system is a lighting system suitable for use indoors learning activities because the reflected light illuminates the whole room, so that all people who move in the room get evenly lighting. The lighting system is also not cause shadows and glare but reduce the total efficient light falling on the surface of the room.

3.2 Standard Lighting In The Room

The intensity of illumination in the room depending on the needs of the type of work. Standard lighting in the room can be seen in the following table:

Table 1. Lighting Levels by Type of Occupation

Jenis Pekerjaan	Contoh Pekerjaan	Tingkat Penerangan yang Dibutuhkan (Lux)
Tidak teliti	Penimbunan barang	80-170
Agak teliti	Pemasangan (tak teliti)	170-350
Teliti	Membaca,	350-700

	<i>menggambar</i>	
<i>Sangat teliti</i>	<i>Pemasangan</i>	<i>700-1000</i>

Sources: Company Hygiene and Health (Suma'mur, 2009)

According to Keputusan Menteri Kesehatan Republik Indonesia No. 1405/MENKES/SK/XI/2002 on Employment Requirements Office of Environmental Health and Industry, are listed in table 2 below:

Table 2. Lighting Levels Standards According Kepmenkes No.1405 of 2002

<i>Jenis Pekerjaan</i>	<i>Tingkat Pencahayaan Minimal</i>	<i>Keterangan</i>
<i>Pekerjaan kasar dan tidak terus menerus</i>	<i>100</i>	<i>Ruang penyimpanan dan ruang peralatan/instalasi yang memerlukan pekerjaan yang kontinyu</i>
<i>Pekerjaan kasar dan terus menerus</i>	<i>200</i>	<i>Pekerjaan dengan mesin dan perakitan kasar</i>
<i>Pekerjaan rutin</i>	<i>300</i>	<i>Ruang administrasi, ruang kontrol, pekerjaan mesin & perakitan/penyusunan</i>
<i>Pekerjaan agak halus</i>	<i>500</i>	<i>Pemeriksaan atau pekerjaan dengan mesin</i>
<i>Pekerjaan halus</i>	<i>1000</i>	<i>Pemilihan warna, pemrosesan tekstil, pekerjaan mesin halus & perakitan halus</i>
<i>Pekerjaan amat halus</i>	<i>1500 Tidak menimbulkan bayangan</i>	<i>Mengukir dengan tangan, pemeriksaan pekerjaan mesin dan perakitan yang sangat halus.</i>
<i>Pekerjaan terinci</i>	<i>3000 Tidak menimbulkan bayangan</i>	<i>Pemeriksaan pekerjaan, perakitan sangat halus</i>

Sources: Kepmenkes No.1405 of 2002

Based on the study of lighting according to standard literature (Suma'mur, 2009) and No. Kepmenkes. 1405 of 2002, so when viewed from the type of work conducted in a room lighting levels

appropriate use of standards is 300-700 lux, which is taken as the conclusion of the experimental design that used the variable light of 350 lux.

3.3 "Effect of ambient temperature on the focus and performance of NASA employees"

NASA published a study about one of the causes reduced ability to concentrate and employee performance. In the EHS Magazine, cited a NASA study on the performance of the telegraph operator who shows some key results are:

- *Pada suhu 26°C, para operator membuat kesalahan 5 kali dalam satu jam dan 19 kesalahan setelah 3 jam*
- *Pada suhu 32°C, para operator membuat 9 kesalahan per jam dan 27 kesalahan setelah 3 jam.*
- *Pada suhu 35°C, para operator membuat 60 kesalahan per jam dan 138 kesalahan setelah 3 jam.*

The study concluded that NASA over the work environment with summer temperatures will affect the error rate of a job. Based on the results of NASA research in the room temperature levels, the temperature variables used in the design of experiments is 26 ° C and 32 ° C.

3.4 Design of Experiments

From the results of different treatment room design that is 2 comparison groups: Interaction temperature 26 ° C with 350 lux illumination and interaction of temperature 32 ° C with 350 lux illumination, the output level of the results obtained studying the activity as follows:

- *The interaction of temperature 26 ° C with illumination intensity of 350 lux, the subject generates an average output of 79 pages in 200 minutes.*
- *The interaction of temperature 32 ° C, and the intensity of 350 lux illumination, subjects produced an average output of 70 pages in 200 minutes.*

Based on the output, then the interaction of temperature 26°C with illumination intensity of 350 lux has an optimal work productivity compared with the interaction of temperature 32°C with illumination intensity of 350 lux. This shows the

influence of the design space based on the temperature and illumination on the productivity of learning (the work).

4. CONCLUSION AND SUGGESTION

The conclusion from this research are :

1. The design room based on the interaction of the temperature level and illumination intensity affect toward the productivity of learning (the work).
2. In designing the room should use artificial lighting sources, methods or diffuse general lighting, indirect lighting systems and light control system for the control of temperature and illumination intensity according to the type of work activity.

The suggestion for this research are :

1. Industry is expected to hand in designing the room should take into account the physical environment and physical room environment control system in order to adapt to this type of work activity.
2. Temperature level and illumination intensity in the room should follow the minimum standards.

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