THE ANALYSIS OF THE EFFECT ON PHYSICAL ENVIRONMENT FACTOR FOR NOISE AND LUMINOUS TO ACCURACY SCORE ON READING AND COLORS MATCHING

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ABSTRACT

Experiment design is long process consists of complex process step and correlated so that it has to be done with critical and systematic process. Analysis technique used in this paper is analysis of variance, is the way to test variance from population.
The main variables in this paper are noise intensity and luminous intensity, while other variables such as temperature, humidity, and times are assumed constant. The respondents are 15, taken from students which are in good health and no color blind and was done in the climate chamber in the laboratory, to read some readings and to match different 20 colors, and all has been scored.
The results are, there is a significance different that luminous intensity affected the reading score and color matching, there is no significant different that noise intensity affected the reading score and color matching, and there is no interaction between luminous intensity and noise intensity for the reading score and color matching.

***Key words**: noise intensity, luminous intensity, analysis of variance.*

1. INTRODUCTION

1.1. Research Background

The most aspect in productivity decreasing is a human resource. Human as a controller and decision maker will feel fatigue while doing their jobs, especially when human has to face machines or tools which could not give comfort ability, physically or mentally, to human being.

The bad work environment will demand more effort and time, such as wrong installation of electronic components that affected by Luminous resolution and noise intensity

1.2 Research Identification

1. Is there any affection caused by reading accuracy and color matching for different luminous intensity
2. Is there any affection caused by reading accuracy and color matching for different noise intensity?
3. Is there any interaction between Luminous intensity and noise intensity on reading accuracy and colors matching?

1.3 Research Objectives

1. To determine the effect of luminous intensity for reading accuracy and color matching
2. To determine the effect of noise intensity for reading accuracy and color matching
3. To determine the interaction between luminous intensity and noise intensity for reading accuracy and colors matching.

2. THEORETICAL BACKGROUND

2.1 Cognitive Ergonomics

As defined by the International Ergonomics Association "is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system. The relevant topics include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design." Cognitive ergonomics studies cognition in work and operational settings, in order to optimize human well-being and system

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performance. It is a subset of the larger field of human factors and ergonomics.

Successful, ergonomic intervention in the area of cognitive tasks requires a thorough understanding not only of the demands of the work situation, but also of user strategies in performing cognitive tasks and of limitations in human cognition. Tools may also co-determine the very nature of the task. In this sense, the analysis of cognitive tasks should examine both the interaction of users with their work setting and the user interaction with artifacts or tools; the latter is very important as modern artifacts (e.g., control panels, software, expert systems, experiment design) become increasingly sophisticated. Emphasis lies on how to design human-machine interfaces and cognitive artifacts so that human performance is sustained in work environments where information may be unreliable, events may be difficult to predict, multiple simultaneous goals may be in conflict, and performance may be time constrained

2.2 Luminous Intensity

In photometry, luminous intensity is a measure of the wavelength-weighted power emitted by a light source in a particular direction per unit solid angle, based on the luminosity function, a standardized model of the sensitivity of the human eye. The SI unit of luminous intensity is the candela (cd), an SI base unit.

Photometry deals with the measurement of visible light as perceived by human eyes. The human eye can only see light in the visible spectrum and has different sensitivities to light of different wavelengths within the spectrum. When adapted for bright conditions (photopic vision), the eye is most sensitive to greenish-yellow light at 555 nm. Light with the same radiant intensity at other wavelengths has a lower luminous intensity. The curve which measures the response of the human eye to light is a defined standard, known as the luminosity function. This curve, denoted $V(\lambda)$, is based on an average of widely differing experimental data from scientists using different measurement techniques. For instance, the measured responses of the eye to violet light varied by a factor of ten.

Luminous intensity should not be confused with another photometric unit, luminous flux, which is the total perceived power emitted in all directions. Luminous intensity is the perceived power *per unit solid angle*. Luminous intensity is also not the same as the radiant intensity, the corresponding objective physical quantity used in the measurement science of radiometry.

2.3 Noise Intensity

The risk of noise to hearing is based upon two factors: noise intensity level (loudness) and the duration of exposure. Noise induced hearing loss has been found to occur with repeated 8 hour exposures of 85 dBA, but shorter exposures to greater levels can be equally as dangerous.

The chart below identifies equivalent noise exposures. Based upon the equal energy law, a doubling of sound energy will result in a 3 dB increase in measured sound level. This 3 dB exchange rate is the recommended method for evaluating the risk of noise exposure. OSHA action levels (which trigger required inclusion in a hearing conservation program) are based upon a 5 dB exchange rate.

Table 1. Noise Intensity Time Exchange

Length of Exposure	NIOSH (3 dB Exchange Rate)	OSHA (5 dB Exchange Rate)
16 hours	82	80
8 hours	85	85
4 hours	88	90
2 hours	91	95
1 hour	94	100
30 min	97	105
15 min	100	110
7.5 min	103	115
3.75 min	106	120

Table 2 Noise Intensity Scale

	Decibel	High Hear Ambience
	120	
Deaf	110	Thunder
		Cannon
		Steam Engine
	100	
Very noisy	90	Traffic Jam
		Fabrication
		Whistle
	80	
Strong	70	Noisy Office
		Normal Traffic
		Radio
		Office
	60	
Mild	50	Noisy House
		Normal Office
		Strong Conversation
		Low Radio
	40	
Quiet	30	Easy Home
		Single Office
		Auditorium
		Normal Conversation
	20	
Very Quiet	10	Leaves sound
		Whisper
		Low Hear Ambience
	0	

2.4 Analysis of Variance

In statistics, analysis of variance (ANOVA) is a collection of statistical models, and their associated procedures, in which the observed variance in a particular variable is partitioned into components attributable to different sources of variation.

In its simplest form, ANOVA provides a statistical test of whether or not the means of several groups are all equal, and therefore generalizes *t*-test to more than two groups. Doing multiple two-sample t-tests would result in an increased chance of committing a type I error. For this reason, ANOVAs are useful in comparing two, three, or more means.

ANOVA is used in the analysis of comparative experiments, those in which only the difference in outcomes is of interest. The statistical significance of the experiment is determined by a ratio of two variances. This ratio is independent of several possible alterations to the experimental observations: Adding a constant to all observations does not alter significance. Multiplying all observations by a constant does not alter significance. So ANOVA statistical significance results are independent of constant bias and scaling errors as well as the units used in expressing observations. In the era of mechanical calculation it was common to subtract a constant from all observations (when equivalent to dropping leading digits) to simplify data entry. This is an example of data coding.

3. RESEARCH METHODS

3.1 Research Variables

Variables used in this paper are:

1. Noise

This noise is unwanted sound and can effect health, conformity, and deafable. There are 3 intensity scale:

a. Quiet, intensity scale is average at 60-75 dB like can be found in normal conversation or single office.
b. Mid, intensity scale is average at 90-105 dB like can be found in noisy house, strong conversation, and normal office.
c. Noisy, intensity scale is average at 115-130 dB like can be found in traffic jam, factory, and whistle blows.

2. Luminous

a. Dim, object is unclearly be seen with luminous intensity was 10 lux.
b. Bright, object is clearly be seen with luminous intensity was 42 lux.
c. Very Bright, object is unclearly be seen due to light bursting with luminous intensity was 110 lux.

3.2 Temperature, Humidity, Time

This research was done in a climate chamber in laboratory, so that the treatments were condition to a room temperature at 24^{O} C, with humidity was average of Indonesian climate is 78%, and time of every treatment was set to 10 minutes

3.3 Respondents and Tools

There were 15 respondents in good health and no blind color between age of 20-25 years. Tools were used :

a. Readings and Questionnaire, were design to a reading on work environment, which was to be scored by the questionnaire.
b. Pictures of Colors and Matching Colors, to measure the effect that may cause by luminous intensity and noise intensity
c. Sound level
d. Light meter
e. Stop watch

3.4 Treatments

Treatments for respondents are following the table.

Table 3. Tabel of Treatments

		Luminous Intensity		
		Dim	Bright	Very Bright
Noise Intensity	Quiet	T1	T2	T3
	Mid	T4	T5	T6
	Noisy	T7	T8	T9

3.5 Experiments

There are 2 experiments to be done by respondents for 10 minutes for every experiment, which are,

1. First Experiment, the respondents were given readings and then fill up the questionnaires. Every treatments have different readings and questionnaires.
2. Second Experiment, the respondents were given a set of colorful picture and then they have to matching the colors into the given table of colors.

Those experiments result then will be scored in a particular table.

4. RESULT AND DISCUSSION

4.1 Climate Chamber

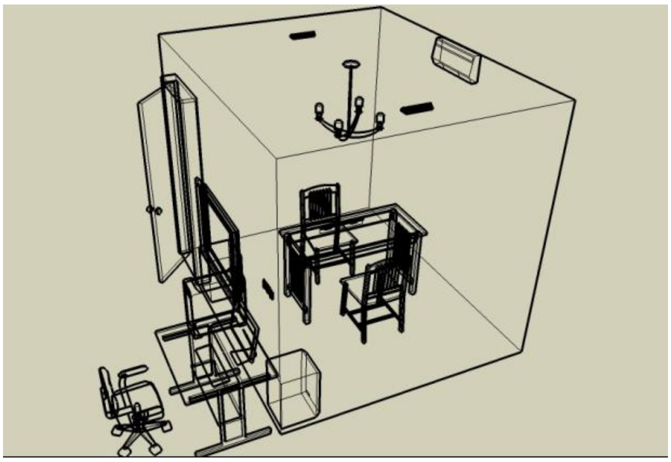

Figure 1. Climate Chamber

4.2 Experiments Result

Table 4. Respondents Score

Perlakuan	Responden															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	3	2	4	3	5	2	3	3	4	3	4	3	3	4	3	49
2	2	2	3	2	5	3	2	4	3	2	4	2	2	3	1	40
3	2	1	1	1	3	1	2	2	2	1	3	1	1	1	1	23
4	4	4	5	3	5	4	4	4	4	3	5	4	3	5	4	61
5	4	3	3	3	3	3	3	4	3	3	4	2	3	4	3	48
6	4	3	2	3	1	1	2	1	2	3	4	1	3	2	2	34
7	5	4	4	4	5	5	3	3	5	5	5	4	4	5	3	64
8	5	4	3	2	4	3	2	3	3	4	4	2	3	3	2	47
9	4	3	2	1	3	1	1	1	2	4	4	2	2	1	1	32

Note:
1. Very Uncomfortable : 0 – 15
2. Uncomfortable : 16 – 30
3. Fair : 31 – 45
4. Comfortable : 46 – 60
5. Very Comfortable : 61 – 75

4.3 ANOVA

Total score from 9 treatments then put into table and make the ANOVA.

Table 5. Treatment's Score

Luminous Intensity	Noise Intensity (dB)			Total
	60-75	90-105	115-130	
10 Lux	1204	1168	1232	3604
42 Lux	1344	1352	1276	3972
110 Lux	1348	1284	1256	3888
Total	3896	3804	3764	**11464**

Hypothesis:

1. H_0 : $\alpha_1 = \alpha_2 = \alpha_3 = \ldots = \alpha_i = 0$
   No significant difference to luminous intensity on reading and matching colors
2. H_0 : $\beta_1 = \beta_2 = \beta_3 = \ldots \beta_j = 0$
   No significant difference to noise intensity on reading and matching colors
3. H_0 : $(\alpha\beta)_{11} = (\alpha\beta)_{12} = \ldots = (\alpha\beta)_{ij} = 0$
   No interaction to luminous intensity and noise intensity on reading and matching colors

Significant level is .05 for all tests, $f_{.05(2,126)} = 3.07$ and $f_{.05(4,126)} = 2.44$

Table 6. ANOVA

Source	SS	df	MS	f
Luminous Intensity	**1652.86**	**2**	**826.43**	**9.998**
Noise Intensity	**203.61**	**2**	**101.81**	**1.232**
Interaction	**462.70**	**4**	**115.67**	**1.399**
Error	**10414.93**	**126**	**82.66**	
Total	**12734.10**	**134**		

From ANOVA table, the result is,

1. Reject H_0, there is a significant difference to luminous intensity on reading and matching colors
2. Accept H_0, No significant difference to noise intensity on reading and matching colors
3. Accept H_0, No interaction to luminous intensity and noise intensity on reading and matching colors

Further test was applied to the result of no 1 with Duncan test to show the difference in luminous intensity, as follows :

Ho : $\alpha_1 = \alpha_2 = \alpha_3 = \ldots = \alpha_i = 0$,

No significant difference within α

Significant level is .05 for all tests

Tabel 7. Mean for Duncan Test

Treatment	a1	a3	a2
Mean	80.09	86.40	88.27

Note: a1 = Luminous intensity 10 lux
a2 = Luminous intensity 42 lux
a3 = Luminous intensity 110 lux

Sy = 1.36

Table 8. Student Confidence Area at 5%,

p	rp (0.05)
2	2.79
3	2.94

Table 9. Shortest Confidence Area at 5%

p	Rp
2	2.79 x 1.36 = 3.79
3	2.94 x 1.36 = 4.00

1. a2 vs a3
   Range = 1.87
   R2 = 3.79
   Range a2 vs a3 < R2, these 2 factors are not signicifant difference.
2. a2 vs a1
   Range = 8.18
   R3 = 4.00
   Range a2 vs a1 > R3, these 2 factors are signicifant difference.
3. a3 vs a1
   Range = 6.31
   R2 = 3.79
   Range a3 vs a1 > R2, these 2 factors are signicifant difference.

Those tests show that the good luminous are condition two and three.

5. CONCLUSION

1. There is a significance difference to luminous intensity on reading and matching colors,
2. There is no significant difference to noise intensity on reading and matching colors
3. There is no interaction to luminous intensity and noise intensity on reading and matching colors
4. The good luminous are condition two and three.

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