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Study of The Effect of Lighting Levels and Wall Colour on Work Productivity (Case Study: Food Cardboard Box Folding in Climate Room LPSKE UNS)

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ABSTRACT: Lighting levels and wall color are thought to have an influence on work productivity, as both are aspects of the physical work environment that can affect visual comfort and psychological atmosphere for workers. This study aims to analyze the effect of lighting levels and wall color on work productivity and find the best combination of results. Through a 3x3 factorial experimental design, the study population consisted of 108 final year students Industrial Engineering in 2019 at Sebelas Maret University. Research used convenience sampling method, 16 subjects were selected as research participants. The observed variables were lighting levels at 75 lux, 100 lux, and 125 lux, as well as wall colors Sage Green, Honey Yellow, and White. Work productivity was measured by folding food cardboard boxes, as a simulated work activity, and the results were measured based on the number of boxes successfully folded in a 10-minute interval. Data processing used Two-Way ANOVA and Regression Response Surface to identify the influence and best results of the variables. The results revealed that lighting level and wall color each had a significant influence on work productivity, with a significance value of 0.000. In addition, the interaction between lighting level and wall color is also significant on work productivity, with a significance value of 0.005. The best result found was using a lighting level of 125 lux and a wall color of White.

Keywords: Lighting Level, Wall Color, Work Productivity, Environmental Ergonomics, Experimental Design

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1. INTRODUCTION

The emergence of a global crisis and similar companies engaged in the same field has resulted in intense competition in the business environment so that companies must have high work productivity by optimally managing their resources. According to Siagian (2019), work productivity is the ability to get the maximum benefit from the available facilities and infrastructure by producing optimal output, if possible the maximum. Companies must be able to build and increase productivity in their environment by thinking about many factors that can make workers comfortable working in the office. The creation of an ideal work environment can be done to improve work comfort, because humans cannot be separated from the various conditions that exist around their workplace, known as the work environment (Sahira, 2018). One of them is by creating an ideal work environment. Work environment indicators can be divided into 2 parts, namely physical and non-physical. Physical includes the level of lighting in the workplace, air temperature in the workplace, air circulation in the workplace, noise in the workplace, wall color in the workplace, decoration in the workplace, security in the workplace (Armanusah, 2017). One of the most influential work environment factors is the level of lighting because it has a direct impact on workers. Appropriate lighting levels help employees feel comfortable and reduce stress in the workplace (Suri & Mariatin, 2018). According to Widarobi, Yadi, & Mariawati (2013), if the lighting level is insufficient, labor productivity can decrease.

Lighting levels are one of the most influential work environment factors because the factor has a direct impact on workers because according to Widarobi (2013), if the lighting level is inadequate, it can cause labor productivity to decrease. Not only lighting levels that affect work productivity, wall color is also one of the influential factors, according to Lee (2011) the effect of wall color is not limited to decorative; wall color also plays an important role in how we feel and respond to our surroundings, wall color can also stimulate us both visually, and emotionally. In addition, wall color has both visual and emotional effects. Costa et al. (2018) state that wall color can affect satisfaction, psychological function, and social function in addition to providing aesthetic value. The influence of wall color is quite important for the occupants of the room, so it becomes an important element and plays an important role in the interior (Zein, Tamara, & Khaerunnisa, 2013).

There are studies that have proven a significant influence between lighting levels and wall color on work productivity. Research by Yeye, Puspandhani, & Maryati (2018) proves that out of 75 rooms in hand-written batik workers, 39 rooms meet the lighting level standards (52%) while 36 rooms do not meet the standards (48%). These results are in line with the number of samples who did not experience eye fatigue, namely 41 workers (54.7%) and the remaining 34 people experienced eye fatigue (45.3%). In addition, based on the p value of 0.000, it can be concluded that lighting levels affect work productivity and fatigue. There is a relationship between wall color in offices in DKI Jakarta and employee productivity, according to research conducted by Alkhathiri and Sari in 2019. Very influential, 83%, and other variables affect 17%. Research by Ruwana, et al. (2021), explained that of the yellow, green, and dark blue wall colors that increase work comfort in the assembly part of the manufacturing industry is the green wall color with a color wave of 460 nanometers increasing to 570 nanometers and can reduce diastole 2.95% and systole 1.29%. The effect of green wall color can reduce heart rate, blood pressure, and pupil size and it has a positive effect on workers' physical comfort.

This study aims to analyze the effect of lighting and wall color on work productivity, the method used is a 3x3 factorial experimental design which will be carried out in the climate room of the Work System Design Laboratory and ergonomics at Industrial Engineering, Sebelas Maret University. The sample taken is 16 final year students of Industrial Engineering Universitas Sebelas Maret who will simulate work activities in the form of folding food cardboard boxes because the activity requires a focus on accuracy so that work productivity can be calculated. The instruments to be studied are the lighting levels of 75 lux, 100 lux, and 125 lux as well as the wall colors of Sage Green, Honey Yellow, and White on work productivity by looking at the number of boxes successfully folded by each sample. Data processing uses Two-Way ANOVA and Regression Response Surface methods to get the best results from the variables studied so that the benefits are obtained by providing recommendations for lighting levels and wall colors for companies to create work productivity.

2. RESEARCH METHODS

This research uses experimental design research which is a method used to determine the impact of a factor on certain variables. In this study, a type of experimental design was used, namely a 3x3 factorial design. The research was conducted in the Climate Room of the Work System Design and Ergonomics Laboratory (LPSKE), Industrial Engineering Study Program, Faculty of Engineering, Sebelas Maret University. This research was conducted from March 27, 2023 to April 6, 2023. The research population was 108 final year students of Industrial Engineering class of 2019 at Sebelas Maret University. Research subjects are individuals, objects, or organisms that are used as sources of information needed in collecting research data. In quantitative research, the determination of research subjects is carried out when the researcher begins to make a research design.

The research subjects were selected by convenience sampling method using 16 research subjects. In this study, the instruments used were 3 lighting levels, namely 75 lux, 100 lux, and 125 lux because the decision of the Minister of Health of the Republic of Indonesia Number 1405 of 2002 states that the lighting intensity in workspaces and manual labor requires a lighting level of 100 lux. The lighting level becomes the standard in the research, while 75 and 125 lux become the comparison. The wall colors to be used are white, green Sage Green, and yellow Honey Yellow because green and yellow have a psychological meaning of color, providing persistence and adding calmness. The white color provides tidiness and order, and is also a basic color that is often used on workplace walls. The folding of food cardboard boxes is a simulation of work activities to determine work productivity by counting the number of food boxes that are successfully folded per 10 minutes and determining that the activity is productive when it produces 20-30 boxes per 10 minutes.

The data collection method used in this study is to collect data with a factorial model, where each participant feels the effect of each treatment given. This model is used to study the relationship between several factors or independent variables with the dependent variable. The following is an illustration of the experimental design used in this study shown on Table 1.

Table 1. 3x3 Factorial

	75 Lux (B1)	**100 Lux (B2)**	**125 Lux (B3)**
Sage Green (A1)	A1, B1	A1, B2	A1, B3
Honey Yellow (A2)	A2, B1	A2, B2	A2, B3
White (A3)	A3, B1	A3, B2	A3, B3

The data processing methods used in this research are Two-Way ANOVA and Regression Response Surface. Before using Two-Way ANOVA, it must go through the Shapiro-Wilk normality test and Levene's homogeneity test.

The Shapiro-Wilk normality test is a statistical method used to test whether a data sample comes from a normally distributed population. The following is the formula for the Shapiro-Wilk normality test.

$$T_3 = \frac{1}{D}\left[\sum_{i=1}^{k} a_i (X_{n-i+1} - X_i\right]^2 \quad (1)$$

$$D = \sum_{i=1}^{n} (X_i - \bar{X})^2 \quad (2)$$

$$G = b_n + c_n + ln\left(\frac{T_3 - d_n}{1 - T_3}\right) \quad (3)$$

Description:
D = Based on the formula below = Shapiro Wilk test coefficients
X_(n-i+1) = The n-i+1th number in the data
X_i = The i-th number in the data
X = Average of the data
G = Identical to the normal distribution Z value
T_3 = Based on the above formula bn, cn, dn = Conversion of Shaprio-Eilk statistics to normal distribution approach

Levene's homogeneity test is a statistical method used to test whether the variations (variants) of two or more groups or samples of data are the same. This test helps in determining whether there is a significant difference between the variants of these groups. Here is the formula for Levene's homogeneity test:

$$W = \frac{(N-k)\sum_{i=1}^{n} n_i (\hat{Z}_i - \hat{Z}_{..})^2}{(k-1)\sum_{i=1}^{k}\sum_{j=1}^{n_i} (Z_{ij} - \hat{Z}_{i.})^2} \quad (4)$$

Description:
n = Number of Observations
k = Number of Groups

Z_ij=|Y_ij-Ŷ_(i.) |
Ŷ_(i.) = Mean of the i-th group
Ẑ_(i.) = Group mean of Z_i
Ẑ_(..) = Overall mean of Z_ij

Two-Way ANOVA is used when the source of variation is not only due to one factor. Other factors that may be a source of response variation must also be considered, such as other treatments or conditioned factors. Consideration of including a second factor as a source of diversity is necessary when the factor is grouped, so that the diversity between groups is very large, but small within the group itself. The purpose of the Two-Way ANOVA test is to determine whether there is an effect of the various criteria tested on the desired results. Two-Way ANOVA is described in table 2 as follows:

Table 2. ***Two-Way*** **ANOVA Analysis**

Source of Diversity	**Sum of Squares**	**Free Degree**	**Center Square**	**FHitung**
Center Row Value	JKB	$r-1$	$s_1{}^2 = \frac{JKB}{r-1}$	$f_1 = \frac{s_1{}^2}{s_3{}^2}$
Column Center Value	JKK	$c-1$	$s_2{}^2 = \frac{JKK}{c-1}$	
Error	JKG	$(r-1)(c-1)$	$s_3{}^2 = \frac{JKG}{(r-1)(c-1)}$	$f_2 = \frac{s_1{}^2}{s_3{}^2}$
Total	JKT	$rc - 1rc - 1$		

$$JKT = \sum_{i=1}^{r}\sum_{j=1}^{c} x_{ij}{}^2 - \frac{T^2_{..}}{rc} \quad (5)$$

$$JKB = \frac{\sum_{i=1}^{r} T_i{}^2}{c} - \frac{T^2_{..}}{rc} \quad (6)$$

$$JKK = \frac{\sum_{j=1}^{c} T.j^2}{r} - \frac{T^2_{..}}{rc} \quad (7)$$

$$JKK = JKT - JKB - JKK \quad (8)$$

Description:
JKT: Total Sum of Squares
JKB: Sum of Row Squares
JKK: Sum of Column Squares
JKG: Sum of Squares of Error

Before performing a response surface regression, a lack of fit test must be performed. The lack of fit linearity test is a statistical method used to test whether the resulting linear regression model fits the data linearly. This test compares the difference between the values predicted by the model and the observed values at points not used to build the model. The following is the formula for the lack of fit linearity test:

$$F = \sum(y_i - \hat{y}_i)^2 - \sum(y_i - \hat{y})^2 \quad (9)$$

Notes:

F = sum of squares of lack of fit.
y_i = observed value at the i-th point.
$\hat{y}_i$ = the value predicted by the model at the i-th point.
$\bar{y}$ = mean of the observed values

Response Surface Regression is a set of mathematical and statistical methods used in modeling and analysis, which aims to see the effect of several quantitative variables on a response variable and to optimize the response variable. In this study, we will look for the level of lighting and the type of wall color that can optimize work productivity. The relationship between these variables can be written in an equation as follows:

$$y = f(x_1 + x_2) + \varepsilon \qquad (10)$$

Where ε_i is the observation error in response y. If the expected value of the response is written E(y)=f(x_1+x_2)=η, then η= f(x_1+x_2) represents a surface called the response surface. So that the optimal equation will be obtained from the model that has been determined.
The formulas for simple linear regression and multiple linear regression equations are explained as follows:

$$Y = a + bX \qquad (11)$$
$$Y = a + b_1 X_1 + b_2 X_2 \qquad (12)$$

Description:
a= constant
b= coefficient of variable X
X= dependent variable
Y= independent variable

The research flow displays the entire process in outline and the software used.
1. Preparation of research instruments using banners as wall colors Sage Green, Honey Yellow, and White and lights using BARDI Smart Lamp operated by Bluetooth.
2. Data collection of work simulations carried out by respondents with different lighting level conditions and wall colors for 9 times on different days for 9 days.
3. Respondents are given 10 minutes to fold the cardboard and the results will be recorded on the observation sheet.
4. Furthermore, the data is collected into excel and carried out a Two-Way Analysis of Variance (ANOVA) test using SPSS to see significance, after which a Response Surface Regression analysis is carried out using Minitab to obtain an equation model to get the best productivity results by determining the best value of lighting level and wall color so that the results of the significance test value and the best results are obtained.

3. RESULTS AND DISCUSSION

3.1. Effect of Lighting Level and Wall Color on Work Productivity

The following are the results of data collection on the number of boxes when performing work simulations with conditions of 3 different lighting levels namely 75 lux, 100 lux, and 125 lux and wall colors in the form of sage green, Honey Yellow, and White on Table 3.

Table 3. Results of Number of Squares at 75 Lux, 100 Lux, and 125 Lux with Sage Green, Honey Yellow, and White wall colors

Respondent's number	Color type	Number of folded boxes		
		75 Lux	100 Lux	125 Lux

1	Sage Green	13	23	22
2		15	21	22
3		15	25	26
4		21	29	26
5		16	17	19
6		21	27	31
7		23	30	26
8		20	22	26
9		20	22	24
10		15	25	26
11		22	27	23
12		12	16	21
13		11	16	17
14		16	23	27
15		20	28	24
16		11	16	20
Total		271	367	380
Average		17	23	24

Table 3. Results of Number of Boxes at 75 Lux, 100 Lux, and 125 Lux with Sage Green, Honey Yellow, and White wall colors (continued)

Respondent's number	Color type	Number of folded boxes		
		75 Lux	100 Lux	125 Lux
1	Honey Yellow	22	21	29
2		23	22	20
3		29	27	31
4		28	29	28
5		21	18	20
6		28	27	27
7		31	25	34
8		30	26	28
9		28	26	27
10		28	29	33
11		28	27	27
12		23	21	26
13		18	22	20
14		27	24	23
15		27	29	28
16		22	23	29
Total		413	396	430

Average	26	25	27

Table 3. Results of Number of Boxes at 75 Lux, 100 Lux, and 125 Lux with Sage Green, Honey Yellow, and White wall colors (continued)

Respondent's number	Color type	Number of folded boxes		
		75 Lux	100 Lux	125 Lux
1	White	30	31	35
2		25	23	25
3		26	28	25
4		28	31	29
5		20	28	30
6		28	34	26
7		30	29	32
8		33	27	34
9		34	30	35
10		32	35	35
11		27	28	29
12		26	29	31
13		23	24	27
14		23	27	29
15		29	33	34
16		26	30	31
Total		440	467	487
Average		28	29	30

The following is a graph of the results of data collection on the number of boxes when performing work simulations with conditions of 3 different lighting levels, namely 75 lux, 100 lux, and 125 lux and wall colors in the form of sage green, Honey Yellow, and White on Figure 1.

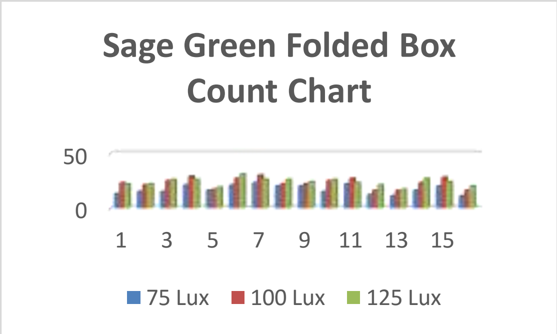

Fig 1. Sage Green Folded Box Count Chart

Figure 1 explains the changes in the number of folded boxes from lighting levels of 75 lux, 100 lux, and 125 lux, it can be seen in the figure that there is an increase in the number of folded boxes at 100 lux and 125 lux, 75 lux tends to decrease.

The following is a graph of the results of data collection on the number of boxes with lighting levels of 75 lux, 100 lux, and 125 lux and honey yellow wall color in Figure 2.

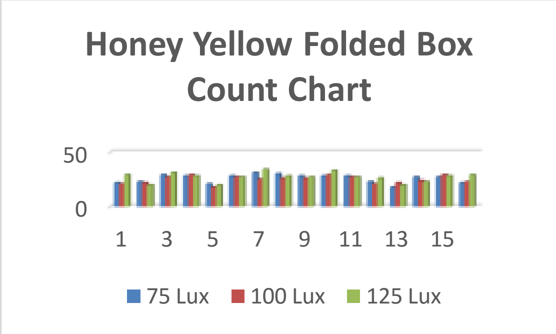

Fig 2. Honey Yellow Folded Box Count Chart

Figure 2 explains the change in the number of folded boxes from lighting levels of 75 lux, 100 lux, and 125 lux, it can be seen in the figure that there is an increase in the number of folded boxes at 125 lux, between 75 lux and 100 lux there is a decrease.

The following is a graph of the results of data collection on the number of boxes with lighting levels of 75 lux, 100 lux, and 125 lux and white wall color in Figure 3.

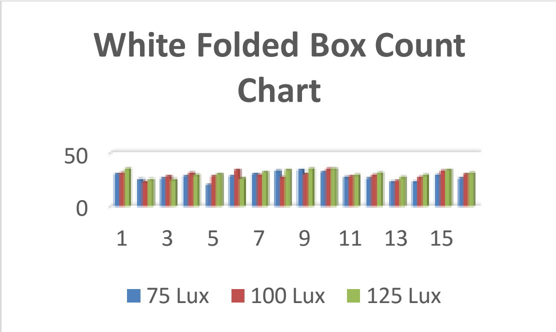

Fig 3. White Folded Box Count Chart

Figure 3 explains the changes in the number of folded boxes from lighting levels of 75 lux, 100 lux, and 125 lux, it can be seen in the figure that there is an increase in the number of folded boxes at 125 lux, from all three lighting levels have increased.

Hypothesis testing is carried out to determine whether the proposed hypothesis can be accepted or rejected (Sardainah, 2019). Hypothesis testing in this study used two-way analysis of variance (Two-Way ANOVA) at a significant level of α = 0.05 (Sardainah, 2019). The following is table 4 of the two-way anova test. results

Table 4. *Two-Way* ANOVA Test

Tests of Between-Subjects Effects					
Dependent Variable: Work Productivity					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Lighting Levels	309.042	2	154.521	10.4470	.000
Wall Color	1487.792	2	743.896	50.404	.000
Lighting Levels * Wall Color	233.667	4	58.417	3.958	.005

The first hypothesis proposed in this study can be answered, namely by looking at the Fcount value and or the significant value (sig.) in the "Lighting Level" row. Based on the table, it can be shown that the F value = 10.447 and the significant value is 0.000. The F value is greater than the Ftable value at the α = 0.05 level (Ftable = 3.81) so it can be concluded that Ho is rejected. In addition, the significant value (sig. = 0.000). By referring to this explanation, it can be concluded that there is an influence of lighting levels on work productivity.

The second hypothesis proposed in this study can be answered, namely by looking at the Fcount value and or the significant value (sig.) in the "Wall Color" row. Based on the table, it can be shown that the F value = 50.404 and the significant value is 0.000. The F value is greater than the Ftable value at the α = 0.05 level (Ftable = 3.81) so it can be concluded that Ho is rejected. In addition, the significant value (sig. = 0.000). With reference to this explanation, it can be concluded that there is an influence of wall color on work productivity.

The third hypothesis proposed in this study can be answered, namely by looking at the Fcount value and or the significant value (sig.) in the "Lighting Level*Wall Color" line. Based on the table, it can be shown that the F value = 3.958 and the significant value is 0.005. The F value is greater than the Ftable value at the α = 0.05 level (Ftable = 3.81) so it can be concluded that Ho is rejected. In addition, the significant value (sig. = 0.005). With reference to this explanation, it can be concluded that there is an effect of lighting levels and wall color on work productivity.

These results are corroborated by the opinion of Sutalaksana (2006) which states that the main function of lighting in the workplace is to illuminate work objects so that they can be seen clearly, easily done quickly, and work productivity can increase. According to Hendrawan (in Padmanaba, 2006) revealed that a good and adequate level of lighting can reduce the level of fatigue so as to increase work productivity. Lighting levels affect work productivity as evidenced by Padmanaba's research (2006) which says that lighting levels that are in accordance with user needs will be able to increase work comfort and effectiveness which ultimately increases work productivity. Lighting characteristics such as lighting levels are significantly correlated with work productivity (Chen, 2022).

3.2. Best Result of Lighting Level and Wall Color

The contour plot graph aims to describe the effect of the combination of lighting level and wall color through different plot colors. Here are the results of the contour plot illustration in Figure 4.

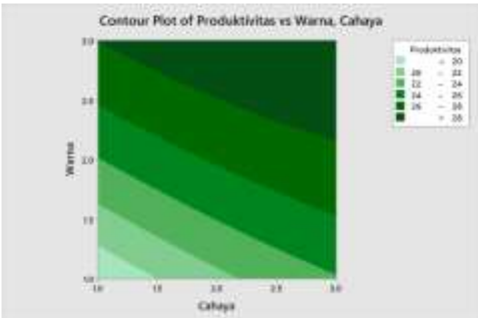

Fig 4. ***Contour Plot***

The contour plot graph in Figure 4 shows that there are differences in the color gradation of the plot in different combinations of light and color. Light and color variables are independent variables in this study. The darker the color of the area indicates the higher the percentage of productivity obtained. Therefore, the dark green color shows the area where the optimum point is reached which is greater than 3.

The surface plot graph aims to help visualize the magnitude of the response for each different treatment through the curvature of the three-dimensional plot. The most optimal surface of all variables is shown with a white area. The following illustrates the surface plot in Figure 5.

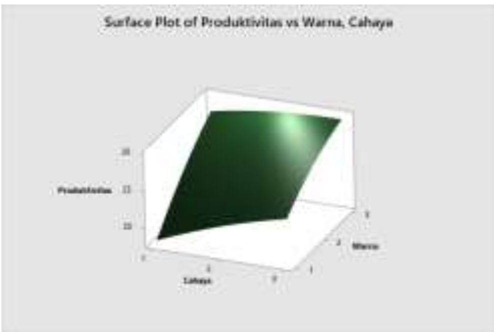

Fig 5. ***Surface Plot***

Based on the surface plot graph in Figure 4.2, it can be seen that the increase in the optimal value of productivity is directly proportional to the increase in light and color until it reaches the optimum point. This condition shows that the optimum point obtained is influenced by light and color.
Then, the research data was analyzed using Minitab 19 software to obtain the design regression layer response optimization, as shown in Table 5.

Table 5. Hasil Terbaik *Response Surface Regresion*

Solution	Lighting Levels	Wall Color	Work Productivity Fit	Composite Desirability
1	2.90308	3	29.7213	0.780054

It can be predicted that the optimum yield, productivity result of 29.7 is obtained at the third light of 125 lux with the third color of white with a D (Desirability) value of 0.78. The value of desirability which is getting closer to the value of 1 indicates the ability of the program to produce the desired product is close to perfect. So that the best results were obtained with a lighting level of 125 lux and a white wall color. The lighting level of 125 lux is corroborated by the statement that lighting levels that are below standard will affect the level of work productivity and health problems in the eyes. Although it does not cause permanent eye damage, it will increase workload, accelerate fatigue, take frequent breaks, lose working hours, reduce job satisfaction, reduce production quality, increase the frequency of errors, disrupt concentration, and reduce the work productivity of each operator (Ilyas, 2003). The effects of lighting levels are positively related to work productivity (Konstanzoz, et. all, 2020).

The white wall color for lighting levels of 75 lux, 100 lux, and 125 lux tends to increase in the number of folded boxes. Based on John F. Pile's theory in Colour in Interior Design (1997), white color in the interior gives the impression of light, clean, and spacious. A sense of comfort can also be obtained from the broad "impression" given by neutral colors. Neutral colors are black, white, and gray. Neutral colors also tend to help increase focus better than an atmosphere that tends to be warm (Setyohadi, 2010). The color white will provide a calm mood, or can even be healing in terms of a sense of calmness, peace, and relaxation (Kaya, 2004). Exposure to the color white can help relieve stress and emotional tension, providing a calming effect on mood. In addition to providing a healing effect, the dominant white color also gives a soft impression (Babolhavaeji, 2015) and a soft impression can provide comfort so that work productivity can increase. The dominant white color can also give a calm impression to human visuals (Chandra, et.al, 2019 & Gunawan, et. al, 2022).

4. CONCLUSION

Here are some conclusions related to the research, namely:

1. Lighting levels of 75 lux, 100 lux, and 125 lux have an influence on work productivity with a significance value of 0.000 and obtained in condition 3 lighting levels of 100 lux and 125 lux tend to increase.
2. Wall colors sage green, honey yellow, and white have an influence on work productivity with a significance value of 0.000 and obtained in condition 3 wall colors honey Yellow and white tend to increase.
3. Lighting levels and wall colors have an influence on work productivity with a significance value of 0.005 and obtained in conditions of lighting levels of 100 lux with honey yellow and white and 125 lux with honey Yellow and white colors tend to increase.
4. The best result of lighting level and wall color is 125 lux lighting level and white wall color obtained from D value of 0.78 and illustration of Countour Plot and Surface Plot results in lighting level of 125 lux and white wall color.

Recommendations for future research are that the distance of lighting levels used in experiments can be shortened and the range of levels can be reduced to less than 100 lux so that lighting levels below a predetermined standard can be studied. The variables studied can be combined with noise, humidity, temperature, and other physical work environment related variables so that research related to the physical work environment can be more concrete. Lighting levels and wall colors can also be varied and more factors examined so that the results of the study can be more accurate.

5. REFERENCES

[1] Adji, A. R, “Kajian kenyamanan visual melalui pencahayaan pada ruang kerja”. *Jurnal Arsitektur ARCADE, 6(1), 135-139*, 2022.

[2] Alkathiri, A. T. B., & Sari, Y, “Pengaruh warna terhadap produktivitas karyawan kantor”. *Jurnal Arsitektur PURWARUPA, 3(3), 187-192*, 2019.

[3] Arianna L., Elisa D. G., Marco D., & Costanzo D. P, “Exploring the use of immersive virtual reality to assess occupants’ productivity and comfort in workplaces: An experimental study on the role of walls colour”. *Journal Energy and Buildings*, 253, 1-18, doi: 10.1016/j.enbuild.2021.111508, 2019

[4] Armanusah, E, “Pengaruh lingkungan kerja fisik terhadap kinerja pustakawan di Badan Arsip dan Perpustakaan Aceh,” Skripsi thesis, UIN Ar-Raniry, 2018

[5] Costa, M., Frumento, S., Nese, M., & Predieri, L, “Interior color and psychological functioning in a university residence hall,” *Frontiers in Psychology, 9*, 1-13. 2018

[6] Fakhari, M., Fayaz, R., & Asadi, S, “Lighting preferences in office spaces concerning the indoor thermal envirotment,” *Frontiers of Architectural Reasearch, 10, 639-651. doi: 10.1016/j.foar.2021.03.00,* 2021

[7] Goethe, W. V., Theory of Colours. Massachusetts: The MIT Press, 2014

[8] Grandjean, E, Fitting the Task to the Man: An Ergonomics Approach. London: Taylor and Francis. 1986

[9] Handoko, T. H, Manajemen Personalia dan Sumber Daya Manusia, Edisi Kedua. Yogyakarta: BPFE. 2011

[10] Herdiyanto, Y. K., *Buku Ajar Ergonomi*. Bali: Universitas Udayana. 2016

[11] Idrus, I, Model pencahayaan alami ruang kelas berbasis persepsi visual siswa sekolah dasar dan menengah di area tropis, Disertasi, Universitas Hasanuddin, 2020

[12] Kaya, N., & Epps, H. H. (2004). Relationship between color and emotion: a study of college students. College Student Journal, 38(3)

[13] Kim, A. A., Wang, S., & McCunn, L. J, “Building value proposition for interactive lighting systems in the workplace: Combining energy and occupant perspectives,” *Journal of Building Engineering, 24, 1-14*. 2019

[13] Lee, V, 10 Principles of Good Interior Design. Seoul: Vivays Publishing. 2011

[14] Rakhima, A. N., & Handoyo, A, “Kajian warna pada interior kelas terhadap kualitas belajar anak di SD Cendekia Muda Bandung,” E-Proceeding of Art & Design, 3 (3), 1089-1100. 2016

[15] Ramadon, S., & Yanti, P, "Pengaruh lingkungan kerja fisik terhadap produktivitas kerja," *Jurnal Universitas Bina Darma,* 3(12), 1–12*,* 2017

[16] Roscoe, J. T, Fundamental Research Statistics for the Behavioral Science, International Series in Decision Process, 2nd Edition. New York: Holt, Rinehart and Winston, Inc. 2007

[17] Ruwana, I., Pratikto, P., Sugiono, S., & Novareza, O, "Increasing workers comfort: Experiment of the effect of color and lighting in assembly manufacture," *Eastern-European Journal of Enterprise Technologies,* 4(10), 59–67*,* 2021

[18] Sahira, Pengaruh lingkungan kerja terhadap kepuasan kerja pegawai pada kantor dinas perhubungan kota Makassar, Skripsi, Universitas Muhammadiyah Makassar, 2018

[19] Siagian, S, Manajemen Sumber Daya Manusia. Jakarta: Bumi Aksara, 2019

[20] Sugiyono, "Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Jakarta: PT Alfabeta, 2014

[21] Suma'mur, P. K, *Higene Perusahaan dan Kesehatan Kerja*. Jakarta: Gunung Agung, 2009

[22] Suri, F., & Mariatin, E, "Pengaruh pencahayaan ruang kerja terhadap stres kerja karyawan biro perencanaan dan kerjasama Universitas Sumatera Utara," *Jurnal Diversita, 3*(2), 9-14, 2018

[23] Sutalaksana, I. Z, Teknik Tata Cara Kerja. Bandung: MTI-ITB, 1979

[24] Sutrisno, E, *Manajemen Sumber Daya Manusia, Edisi Pertama*. Jakarta: Kencana Prenada Media Group, 2016

[25] Wahyuningsih, S, "Pengaruh lingkungan kerja terhadap produktivitas kerja," *Jurnal Warta*, 57, 1-10, 2018

[26] Wibowo, F. P, "Pengaruh komunikasi, konflik, stres kerja, dan lingkungan kerja terhadap produktivitas karyawan," *Jurnal Manajemen Sumber Daya Manusia, 12(2), 211– 228*, 2018

[27] Widarobi, R., Yadi, Y. H., & Mariawati, A. S, "Pengaruh pencahayaan terhadap beban kerja mental di area kerja scroll cut," *Jurnal Teknik Industri, 1(3), 193-199*, 2013

[28] Yang, W., & Moon, H. J, "Combined effects of acoustic, thermal, and illumination conditions on the comfort of discrete sense and overall indoor environment," *Building and Environment, 148, 623-633,* 2019

[29] Yeye, N., Puspandhani, M. E., & Maryati, S, "Hubungan pencahayaan ruangan dengan keluhan kelelahan mata pada pekerja batik tulis di Desa Trusmi Kulon Plered Kabupaten Cirebon," *Jurnal Kesehatan Mahardika, 5(2), 46-51,* 2018

[30] Zein, A. O., Tamara., & Khaerunnisa, "Hubungan warna dengan tingkat stress pengunjung," *Jurnal Reka Jiva, 1*(1), 1-10, 2013.

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