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Experimental Study of the Classical Music and Light Intensity Effect on the Heart Rate of the Readers (A Case Study in Industrial Engineering Library, Diponegoro University)

Heru Prastawa[1a◆], Novie Susanto[1b], Manik Mahachandra[1c]

Abstract. *This paper aims at determining the effect of music and light intensity on heart rate and perceptions of visitors in Industrial Engineering Library, analyzing the performance of users in various treatment conditions and by doing so, providing recommendations for the right combination of treatments to increase concentration and increase the level of relaxation. It proves students' better performance when they work in better physical environment design, especially in the library. Based on preliminary studies, it is indicated that the Industrial Engineering Library (IEL) needs re-engineering of the light and sound condition. The library room does not inline with the Head of National Library of Indonesia's rules, number 13 of 2017, about the national standard of college libraries for lighting condition. Besides, about 90.2% of students feel the classical music increases comfort and concentration in reading activities. The research data was collected by recording 24 respondents' heart rate and processed by experimental design using SPSS software. The result provides recommendations from the human physical aspect by selecting the treatment to achieve the highest performance. An additional questionnaire with a Likert scale was disseminated to measure the respondents' perceptions. The results showed that the interaction of 200-600 lux lighting and classical music variables was the best treatment to achieve the highest performance.*

Keywords: *classic, music, light intensity, heart rate, library.*

I. INTRODUCTION

Industrial Engineering Library (IEL) UNDIP is a reading room located on the second floor of the Industrial Engineering Building at Diponegoro University. Students widely use IEL to find references to support lecture activities. Besides, IEL is also often used to conduct discussions and work on assignments. Therefore, IEL must have a proper physical environment that can support these activities. It is needed to prevent a high mental or physical load due to an improper environment. The right lighting is also required so that the eyes do not get tired quickly in activities (Chen et al., 2017). According to the rules of the Head of the National Library of the Republic of Indonesia number 13 in 2017 about the national standard of university libraries, it is recommended to use 200 lux or 400 lux light intensity, and 20-25 °Celsius temperatures range for reading activities in public reading rooms. The physical environment must be adjusted to the human population that uses the room because each physical human being will show various acceptance levels of different physical environmental conditions. If the physical environment's control is proper with the standard, then human performance can be ensured to be maximal. It is characterized by high concentration and high productivity (Rahmillah, 2016).

The second variable studied is light. Lighting in the workplace has influence employee performance in several ways such as eye strain and visual comfort (van Bommel & van Beld, 2004; Boyce, 2003), cognitive performance, and problem-solving ability by interfering with physiological factors like circadian rhythms (Juslen & Tenner, 2005) as well as the impact on mood and interpersonal relationships at work and therefore job satisfaction (Boyce, 2003). The recent light intensity is still not following the

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Maintenance Cost Analysis Using Cost of Unreliability (COUR) Method with Business Consequence Analysis: A Case Study of a Shot Blast Machine

Jasmine Raisya Salsabila[1a◆], Fransiskus Tatas Dwi Atmaji[1b], Aji Pamoso[1c]

Abstract. *Losses caused by unreliable machines in a production line will affect the total cost losses from a manufacturing company's production process. Based on historical data of damage that has been obtained from the maintenance department of XYZ companies, the MACH MWJ 9/10 Shot Blast Machine is the machine that has the highest-level frequency of damage. This machine is useful for cleaning sand or residual production dirt that sticks to workpieces that have been cast in the casting process, especially for E-Clips components. The research's purpose is to determine the value of cost losses due to machine unreliability using the Cost of Unreliability (COUR) method, with Business Consequence analysis (BC) analysis. The cost effects of these costs include Corrective COUR and Downtime COUR. The final calculation of COUR shows that the total cost of COUR Downtime caused by the unreliability of the machine is greater than the total Corrective COUR. After calculating the COUR, an analysis of the business consequences resulting from the machine's unreliability is carried out using a risk matrix. The analysis results show that the shot blast machine's critical components are in the red or high-risk category and have a very high Probability of Failure (PoF). The results of COUR analysis with business consequence analysis will be an input for the company to make a machine maintenance system policy, especially for the MACH MWJ 9/10 Shot Blast machine's critical components. In general, this research's novelty is to combine the application of the Cost of Unreliability method with an analysis of the effects of the Business Consequence caused by the machine's selected critical components.*

Keywords: *Cost of Unreliability, Maintenance, Corrective, Downtime, Business Consequence.*

I. INTRODUCTION

The role and function of machine maintenance in the modern manufacturing industry have grown rapidly, becoming increasingly important and more challenging in today's dynamic business environment (Atmaji, 2015). This change because the machine maintenance function's effect will significantly impact its total costs in the company's production cycle (Alhilman, 2017). Machine maintenance is generally defined as a combination of all technical, administrative, and managerial actions during a given cycle to maintain or restore a state in which the machine can perform the functions as required (Bokrantz et al., 2020). Machine maintenance is carried out as a strategic decision to eliminate and minimize the potential for failure, breakage, stopping, and damage to equipment or machines (Patidar et al., 2017). The purpose of machine maintenance is to maintain the reliability of the machine so that it can operate properly. Therefore, a good, precise, and consistent strategy is needed to maintain the production process's continuity. If a company is unable to perform proper machine maintenance, it will cause the machine to be unreliable and cause losses, both time loss and total production cost loss. The cost of unreliability caused by a damaged production machine can be calculated using the Cost of Unreliability (COUR) method (Alhilman, 2017; Vicente, 2012).

According to research by (Crespo Márquez et al., 2012; Salonen & Deleryd, 2011b, 2011a; Stenström et al., 2016), all costs that are the result of all situations related to the problem of failure, including costs associated with the maintenance program that is not run correctly will be affected into general production cost. Meanwhile, the COUR studies production facilities as a network for system reliability and the costs incurred when the system fails to do its work, which is used to

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Disruptions Control on Precast Concrete Supply Chain in Construction Projects

Iveline Anne Marie[1a◆], Nilla[1b], Nora Azmi[1c], Yayang Ade Suprana[1d]

Abstract. *Agility amid uncertain circumstances is key to all-across sustainable industries. The construction industry depends heavily on projects as potent drivers to their operational activities regardless of projects' hardwired constraints—shipment, resistance to risks— to affect Key Performance Indicator (KPI). PT ABX, as one of the Indonesian precast-concrete manufactures, is the object of this research aiming to find precautionary strategies for controlling disruptions to the concrete supply chain in construction projects. It considers such supply-chain disruptions, and therefore, the two-layered House of Risk (HOR) model to subsume risks identification, and risks control is applicable for minimizing possible disruptions. It finds risk events, some of which are classified as critical risk events and preventive actions against risks. The findings contribute to a working framework for managers responsible for applying effective strategies for preventing such disruptions.*

Keywords: *house of risk; risks; disruptions, construction projects, supply chain.*

I. Introduction

Intense competition over product innovation, production, and performance in the precast concrete industry leaves the players bruised. The supply chain within management concept refers to the inseparable production process, distribution, and marketing as consumers are exposed to their-desired products available in markets. At the same time, producers are capable of producing products amounts, quality, proper-market location are subject to preliminary plan (Saptana et al., 2016). While working towards fulfilling consumers' expectations, projects should be quite agile in managing possible-yet-common risks to impact preliminary-planned aims (PMI, 2008). Projects apply risk management in order to unknown risks amid the ongoing projects, and therefore, cost and time efficiency, as well as quality properness, are achievable (Nurlela and Suprapto, 2014).

Any activities inseparable from supply-chain management bound to risks as Handayani (2016) theorizes uncertainties (i.e., demand, capacities, time shipment, cutting-edge technology, market changes, intense competition, political upheaval, and government regulations) embedded in the supply chain are initial agents to spark risks. One risk agent commonly has domino effects of sparking other risks, and PT ABX precast supply chain is also exposed to domino-effect risks.

Marie et al. (2015) have conducted research of a model of disruptions control applied in processed bread makers and beef-sausages makers. That model anticipates and prevents any disruptions from supplying, demand, internal production system and varies in sub-models it has (i.e., preventive actions against disruptions, advanced policies of controlling disruptions, and inventory tolerance. The sub-model of preventive actions against disruptions recommends rule-based mechanisms to control disruptions; the sub-model of policies of controlling disruptions generates prevailing regulations against disruptions, and the sub-model of inventory tolerance by means of average disruptions produce safety stock value.

Each of the disruptions and preventions against them is recorded in a certain database whose names are input and locked with keywords. Should any disruptions occur, proper

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Experimental Study of the Classical Music and Light Intensity Effect on the Heart Rate of the Readers (A Case Study in Industrial Engineering Library, Diponegoro University)

by Novie Susanto

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standards of the Head of the National Library regulations. The actual light intensity of IEL is around 150 Lux on cloudy days and can reach 600 Lux when it is bright. It uses natural lighting. A preliminary study involving 41 students from the active class produce 58.5% of students felt the condition of IEL light on cloudy days would be too dark and would be too bright if the conditions were bright. Many problems, such as eyes are quickly tired (48.8%) and vision interference (41.5%). Thus, convenience at IEL needs to be improved. As many as 90.2% of students also support playing classical music in the room. Students feel that classical music can add comfort and concentration in doing activities. 78% of students felt that further research was needed on the re-engineering of IEL's physical environment. This experiment was conducted using classical music and light intensity on the student's heart rate. A low heartbeat per minute (relaxed) and a slight surge in heart rate will affect the ease of concentration and increase relaxation.

Music has also been widely used in multiple clinical fields, particularly as a form of complementary and alternative medicine due to its non-invasive and easily accessible features (Chlan et al., 2013). Moreover, music has been reported to positively decrease pain and anxiety during burn dressing changes (Witte et al., 2019). Currently, most studies have focused on hospitalized burn patients rather than outpatients, and only a few studies have examined the effect of combining music with tramadol on burn patients. The study was designed to analyze tramadol's effect and its combination with self-selected music on burn outpatients undergoing dressing changes and to provide recommendations for future research and clinical practice. The following influences of music that can produce mental and physical effects, namely (Campbell, 2001): covers up unpleasant sounds and feelings, can slow down and balance brain waves, influences feelings, affects heart rate, pulse, and blood pressure. Music also reduces muscle tension and improves body movement and coordination, affects the body temperature, increase endorphin levels by regulating hormones related to stress, strengthen memories and lessons, increase productivity, and cause a sense of security and prosperity. The condition change of light intensity correlates with the quality of the image. The high light intensity would smear a picture while at the same time, a low light intensity would dim an image. The facility used for data collection was illuminated by fluorescent light and light from the surrounding environment. The result shows that three different illumination levels impact heart rate ranging from 310 lux to 560 lux (Pears, 1998; Minolta, 2016).

Heart rate is a physiological appearance of the heart rate measured in units of time (minutes). Heart rate is well related to the human autonomic nervous system. The autonomic nervous system has divided into two: the sympathetic nervous system and the parasympathetic nervous system. The sympathetic nervous system functions to extend the body's response to do quite strenuous activities or in exchange with stressful situations. In activities like this, the sympathetic nervous system will control the heart to beat faster and sponger. The parasympathetic nervous system dominates calm and relaxed activities or conditions to regulate the heart not to beat fast and strong.

Heart rate is an important parameter to estimate the physiological state of an individual/person. Traditional electrocardiogram (ECG) and pulse oximeter attached to the fingertips or earlobes were used to measure the heart rate. These methods often caused discomfort to the patient (Hassan et al., 2016). The ability to monitor heart rate remotely by non-contact means is a growing interest in healthcare (Zhang, 2017). The heart rate, respiratory rate, breathing rate, and oxygen saturation are commonly analyzed physiological parameters. Some recent studies related to the effect of music and its physical measurement in the library have been performed by Aubert (2003), Hargreaves (2008), Mori (2014), Guspriyadi (2014), Trimmel (2015), Aysia et al. (2016), and Chen et al. (2017).

Based on some problems and related background, this study aims at determining the effect of music and light intensity on heart rate and perceptions of visitors in IEL, analyzing the performance of users in various treatment conditions and by doing so, providing recommendations for the right combination of treatments to increase concentration and increase the level of relaxation.

II. RESEARCH METHOD

According to Gay (1992), sampling must be taken with a large amount, assuming that the more samples are taken, the more representative the data is. The results can be generalized, as well. However, the sample size studied is very dependent on the type of research conducted. An experimental requires at the minimum 15 samples per treatment or group. There are at least 15 respondents with four treatments. However, as the results of a randomized study, a scheme is needed in data collection. The scheme is a counterbalancing scheme. The respondent used is the same for every treatment (within-subject). From the counterbalancing scheme, the number of respondents is 24 respondents. The treatment of experimental design was performed in the library to achieve actual lighting and other physical condition.

The purpose of the experimental design is to obtain and collect information needed in conducting research. It is done as efficiently as possible, considering the time, cost, energy, and materials used. It is also essential to note that simple designs are easy to implement, economical, and the data obtained based on such designs can be quickly analyzed. Through this, it can be concluded that the experimental design aims to bring maximum information by using a minimum cost to analyze concluding a study. The research model can be seen in Table 1.

Table 1. Research Model

Lighting (lux)	Music Conditions	
	Without Music	Classic Music
<200 or >600	*Heart Rate (bpm)*	*Heart Rate (bpm)*
200-600	*Heart Rate (bpm)*	*Heart Rate (bpm)*

The hypothesis in this study was built from an experimental design model based on the research variables. The independent variables were music (sub-variables: with Mozart classical music (Taylor, 2012) and without music) and light intensity (sub-variable: <200 or >600 lux as an actual condition and 200-600 lux as the treatment), while the dependent variable was heart rate (beat per minutes). The treatment is detailed as follows:

a. Treatment A, Respondents read a book at <200 or >600 lux light intensity without music for a specified time (10 minutes)
b. Treatment B, Respondents read a book at <200 or >600 lux light intensity with classical music for a specified time (10 minutes)
c. Treatment C, Respondents read a book at 200-600 lux light intensity without music for a specified time (10 minutes)
d. Treatment D, Respondents read books at 200-600 lux light intensity with classical music for a specified time (10 minutes)

The questionnaire design in this study is closed-model questionnaires or questions that limit the respondents' choices. The choice of answers is available in the questionnaire in the form of a scale that illustrates the respondents' approval of an argument about this study's topic. The study's determination was based on Othman and Mazli (2012) research for light variable and White (2007) for music variable. The assessment is set with a Likert scale of five (5) points as a measurement level from strongly disagree to agree strongly. Table 2 shows the variables and indicators of the questionnaire.

This study measures the physical and perception of the respondents. The physical condition is determined based on the respondent's heart rate using the L381 Smart bracelet, while Lux Meter was utilized to measure the light intensity. The physical environment condition is altered so that the researchers have designed it to measure the best heart rate treatments. There were two variables, and each variable had five indicators of physical environment assessment the respondent.

The physical aspect of the respondent the measurement is carried out through the respondent's heart rate. It then tested using the classic assumption test. After passing the classic assumption test, the data were processed using the ANOVA test to see the significance level. After finding significant differences, the Post Hoc (Tukey) test was then performed to determine which treatments were significantly different based on each treatment's average heart rate. In terms of respondents' perceptions, measurements were made using a Likert scale. It was performed after the validity and reliability tests were carried out. The median analysis conducted the process of questionnaire data to obtain a score for each indicator. Scores of these indicators were categorized according to the division of a predetermined range of categories (Mawaddah, 2014).

III. Result and Discussion

The descriptive analysis of data can be seen in Table 3, while the contour mapping in IEL UNDIP can be seen in Figure 2. Figure 2 shows that the light intensity range is quite extensive because the room's physical conditions are close to the window with a wide opening, and some parts are far from the window. Meanwhile, the

Table 2. Variable and Indicator of Questionnaire

No	Variable	Indicator	Question
1	Light	Contrast	I feel that the distinction between outdoor and indoor light in the treatment (A / B / C / D) is appropriate
		Brightness	I feel the light's brightness in the treatment (A / B / C / D) is appropriate.
		Blair	I feel dazzled when reading about the treatment conditions (A / B / C / D)
		Time Spent	I feel the light settings on the treatment (A / B / C / D) influenced me to read on RBTI for a long time.
		Adequacy	I feel it is enough when reading in the light conditions of the treatment (A / B / C / D)
2	Music	Consistency	I feel background music in the treatment (A / B / C / D) makes me consistent in the work that I do
		Behavior	I feel background music on treatment (A / B / C / D) helps me do positive behavior?
		Drowsiness	I feel background music on treatment (A / B / C / D) makes me sleepy
		Concentration	I feel that background music in the treatment (A / B / C / D) helps me concentrate maximally.
		Relaxation	I feel that background music in the treatment (A / B / C / D) helps me feel relaxed while reading a book.

Table 3. Descriptive Statistics Data

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Treatment_A	24	37,00	63,00	100,00	81,4583	1,51679	7,43072	55,216
Treatment_B	24	44,00	60,00	104,00	80,3750	1,88704	9,24456	85,462
Treatment_C	24	30,00	66,00	96,00	81,1250	1,55726	7,62896	58,201
Treatment_D	24	19,00	65,00	84,00	73,9583	0,95074	4,65766	21,694

Table 4. Interaction of Each Treatment

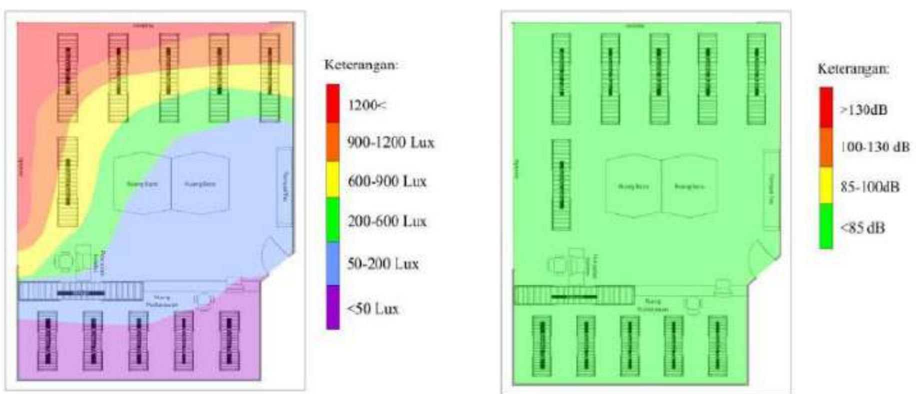
Interaksi	n	df	Mean Square	f	Sig.
Treatment A><B	24	1	14,0,83	0,200	0.657
Treatment C><D	24	1	616,333	15,429	0.000
Treatment A><C	24	1	1,333	0,024	0.879
Treatment B><D	24	1	494,083	9,222	0.004

relative noise range is less than 85 dbA.

The normality test showed that data is normally distributed (α > 0,05) and homogenous (α=0,116) for all treatments. ANOVA results (Table 4) found a significant interaction effect of music and light in treatment C >< D (sig. 0.00) and B >< D (sig. 0.004). It means the treatment significantly affects the respondent's heart rate. It contradicts Alexander's (2012) research that shows an insignificant difference (p-value = 0,5202) for the result of a paired comparison test using heart rate as the measured variable.

Table 5 showed the average heart rate data based on variations in lighting and music conditions. It shows the significance value for the music variable (sig. = 0.28), light variable (Sig. = 0.008) and the interaction between music and light variables (sig. = 0.048). It can be concluded that there was a significant difference in average heart rate based on variations in lighting and music conditions. In further analysis, the POST HOC test in Table 6 using the Tukey test is used to determine which treatments are significantly different. From the Post Hoc test conducted, Treatments A, B, and C differed significantly from Treatment D. The significant differences were found for the comparison of Treatments A and D (sig. = 0.004), Treatments B and D (sig. = 0.018), Treatments C and D (sig. = 0.006).

To reveal the interactions between the light and music variables, Figure 2 plotted the means of existing experimental designs. The means plot showed a significant interaction between light and music variables as the line is in an ordinal interaction state where Treatment D differs significantly from other treatments. After knowing the ANOVA value and the interaction between light and music variables, the next step was to



(a) (b)

Figure 2. Contouring map of light intensity (a) and noise intensity (b) in IEL UNDIP

Table 5. Two Way ANOVA result

Source	Sum of Square	df	Mean Square	f	Sig.
Dependent Variable: Average *Heart rate*					
Corrected Model	903,792	3	301,264	5,463	0,002
Intercept	602617,042	1	602617,042	10928,237	0,000
Light	408,375	1	408,375	7,406	0,008
Music	273,375	1	273,375	4,958	0,028
Light*Music	222,042	1	222,042	4,027	0,048
Error	5073,167	92	55,143		
Total	608594,000	96			
Corrected Total	5976,958	95			

compare each treatment's average heart rate to find a significant difference in the treatment.

In the processing of the questionnaire, the validity and reliability tests were first performed. The result showed that the questionnaire both were valid (r calculated > 0.404) for all questions and reliable (Cronbach's alpha > 0.6) for all treatments. The further process calculates the interval between one criterion with another criterion that moves from numbers 1 to 5. It aims at finding the lower boundary value, quartile I, median, quartile III, and upper limit. The result was classified as follows: 96 <score <120 (very good), 72 <score <96 (good), 48 <score <72 (bad), 24 <score <48 (very bad) and the median analysis was obtained as in Table 7.

In terms of respondent's cognition (perception), the results obtained were that Treatment A, B, and C were acceptable according to respondents' perceptions. Treatment A needs improvement to accommodate the indicators of glare, time spent, and adequacy. Treatment B needs improvement regarding the indicators of adequacy and relaxation. As for Treatment C, the indicators of brightness, behavior, drowsiness, and concentration were the focus of

Table 6. Post Hoc Test.

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Treatment A	Treatment B	1,08333	2,14366	0,958	-4,5258	6,6925
	Treatment C	0,33333	2,14366	0,999	-5,2758	5,9425
	Treatment D	7,50000	2,14366	0,004	1,8909	13,1091
Treatment B	Treatment A	-1,08333	2,14366	0,958	-6,6925	4,5258
	Treatment C	-0,75000	2,14366	0,985	-6,3591	4,8591
	Treatment D	6,41667	2,14366	0,018	0,8075	12,0258
Treatment C	Treatment A	-0,33333	2,14366	0,999	-5,9425	5,2758
	Treatment B	0,75000	2,14366	0,985	-4,8591	6,3591
	Treatment D	7,16667	2,14366	0,006	1,5575	12,7758
Treatment D	Treatment A	-7,50000	2,14366	0,004	-13,1091	-1,8909
	Treatment B	-6,41667	2,14366	0,018	-12,0258	-0,8075
	Treatment C	-7,16667	2,14366	0,006	-12,7758	-1,5575

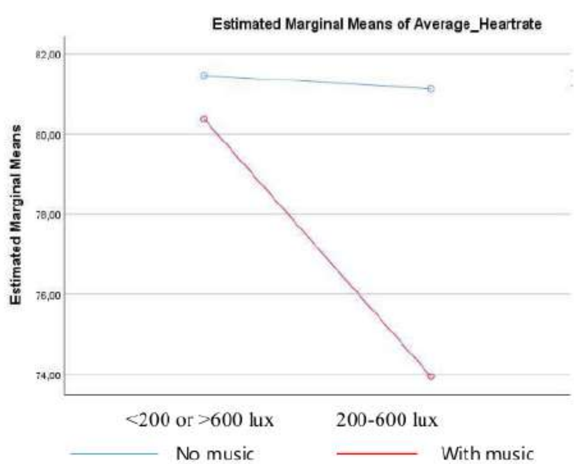


Figure 2. Means Plot HR Treatments Chart A, B, C, D.

Table 7. Results of Questionnaire Processing using the Weight Means Score Method

Indicators	Treatments A		Treatments B		Treatments C		Treatments D	
	Score	Qualitative Description	Score	Qualitative Description	Score	Qualitative Description	Score	Qualitative Description
(C1) Contrast	81	Good	84	Good	81	Good	92	Good
(C2) Brightness	88	Good	81	Good	77	Good	91	Good
(C3) Blair	72	Good	85	Good	85	Good	86	Good
(C4) Time Spent	79	Good	85	Good	81	Good	98	Very good
(C5) Adequacy	77	Good	79	Good	78	Good	89	Good
(M1) Consistency	92	Good	85	Good	88	Good	89	Good
(M2) Behavior	88	Good	83	Good	77	Good	94	Very good
(M3) Sleepiness	80	Good	82	Good	76	Good	96	Very good
(M4) Concentration	87	Good	83	Good	79	Good	86	Good
(M5) Relaxation	87	Good	79	Good	82	Good	88	Good
Total	831		826		804		909	

Table 8. Ranking of each treatment

Ranking	Measurement	
	Physical	Questionnaire
1	D	D
2	B	A
3	C	B
4	A	C

improvement. All treatment Indicators were included in the excellent category except the time spent indicator, behavior, and drowsiness, which are included in the excellent category. From comparing the four treatments, it can be concluded that the best treatment is Treatment D, where all the indicators are classified into good and excellent categories. This study provides a synchronization result of study both for physical term and respondent's cognition term. The results on the physical side expressed the best results are Treatment D, while in terms of the questionnaire, treatment D referred to the best product. Table 8 provides a ranking summary result for each treatment.

Synchronization occurs due to the response conformity between the human central nervous system processes and the respondents' stimulus. Further, this condition affects the respondent's physical comfort, which is marked by a low heart rate and the respondent's cognition observed by the increasing level of relaxation and the respondent's concentration when reading a book. The light variable is very influential on the human eye. A good lighting system is enabling humans to move well. Good lighting reduces nerve fatigue, as well.

Some following recommendations in terms of light intensity are established to achieve a better physical environment in the library based on literature review includes using LED lights and sunlight as an alternative solution to minimize fluctuations in sunlight (Choi, 2016), redesign the layout of the room to optimize the existing light intensity because the light intensity affects the seating of visitors (Othman, 2012), prevent the presence of glare from the window by using curtains or dark glass (Books, 1997), designing indirect lighting uses fluorescent lighting to light up the ceiling color where the ceiling height is at least nine feet-6 inches (Malman, 2004) as well as installing lights with high Correlated color temperatures (CCT) (6000 Kelvin) for tasks or jobs that require high concentration or install lights with medium level CCT (4000 Kelvin) for activities that require a long duration (Shamsul, 2013).

Music variables are very influential on human cognition and allow humans to achieve a maximum concentration state. The following recommendations in terms of music are established to achieve a better physical environment of the library includes using relaxing music with an atmosphere of relaxation to maximize the performance of autonomic nervous systems in reducing the performance of stressors efficiently (Myriam, 2013), conducting further surveys about the level of pleasure from various types of music available to make visitors more effective in concentrating because they listen to music they like (Mori, 2014), listening to music with low intensity (low noise intensity, 45 dB) for better reading performance (Chen, 2017), using a headset so that the sound of music is more focused and does not interfere with other visitors (Oldham, 1995), listening to classical music by Mozart in improving the spatial ability of visitors who come (Thompson, 2001).

IV. CONCLUSION

Some interactions are significant between the light and the music variables. The occurrence of an optimistic synchronization between physical and human perception is obtained to establish the recommendations. Treatment D (200-600 Lux and classical music) produces the best result of the experiment. The treatment improves the respondent's physical comfort, characterized by a low heart rate. It affects the respondent's cognition by increasing the relaxation level and the respondent's concentration when reading a book. The following suggestions for IEL are maximizing the lamp to get light intensity following government recommendations or in research, play classical music in the room to relax and increase the level of concentration.

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