Turnitin Journalofphysics

by Wildanul Isnaini

Submission date: 25-Jun-2021 11:51AM (UTC+0700)
Submission ID: 1611884821
File name: Journal_of_Physics.pdf (844.92K)
Word count: 2934
Character count: 14773

Journal of Physics: Conference Series

PAPER • **OPEN ACCESS**

The effect of temperature on measurement accuracy

To cite this article: H A Khoiri *et al* 2019 *J. Phys.: Conf. Ser.* **1381** 012061

The effect of temperature on measurement accuracy

H A Khoiri[1*], W Isnaini[1] and T A Edison[1]

[1] Industrial Engineering Department, Universitas PGRI Madiun, Madiun, Indonesia

Email: halwaannisa@unipma.ac.id (corresponding author)

Abstract. The work environment gives some effects on the employee. One of these is the temperature. Inappropriate working temperatures can interfere with employee work performance. This study aims to proof the effect of temperature on the work efficiency by using the student as a respondent. The student must finish the task in two type temperature condition: with Air conditioner (AC) and no air conditioner (Non-AC). The task was to measure twenty-five workpieces (length and diameter) repeatedly using five types of measuring instruments. Different environmental temperatures are thought to affect student concentration during repeated measurements. The effect of temperature on the measurement results was tested using Two Way ANOVA. Other factors that are taken are the measuring instruments. The results obtained are the temperature conditioned using AC and Non-AC affect the measurement results with p-value<0.05. In addition, the temperature and measuring instruments together influence the measurement results with p-value <0.05.

1. Introduction

Employee performance is an important factor for the progress of a company. One of the things that supports employee performance is the working environment. A conducive working environment is closely related to how an employee can complete a task or job [1].

In the working environment, temperature becomes an important component because it is related to how the body can survive in different temperatures. Improper temperature can interfere employee concentration in completing their works [2]. In industry, one type of task or job that requires concentration is quality control, one of which is workpiece measurement. In measuring workpieces, especially measurements made repeatedly, an employee must maintain the stability of his concentration so the quality control can be completed properly.

In previous studies, the temperature can affect employee performance. According to [3], inappropriate temperatures make that the results of the work are not optimal. Another study was conducted by [4] who examined the effect of temperature and noise on the workload of the production operator's cardiovascular system. The temperature used in the experiment used two levels, and the results obtained that the temperature significantly affected the cardiovascular system and contributed 17.556%. This paper analyse how temperature affects the results of repeated measurements on a workpiece. These measurements are carried out in the laboratory so that after this analysis can be used as suggestions in laboratory settings to optimize the student practicum.

Journal of Physics: Conference Series **1381** (2019) 012061 doi:10.1088/1742-6596/1381/1/012061

2. Literature Study

The literatures used in this paper is as follows.

2.1. Ergonomic

Ergonomics is a branch of science that studies human traits, abilities, and limitations that are useful for designing working systems so that humans can work comfortably [5]. The purpose of ergonomics as follows.

a. reduce injuries and illnesses that occur at work,
b. improve social welfare through improving the quality of social contacts, managing and coordinating work appropriately
c. creating a rational balance between aspects, namely technical, economic, anthropological, and cultural aspects of each work system carried out to create high quality work.

Another definition of ergonomics according to Manuaba (1999) is the ability to apply information based on human character, capacity, and limitations on the work system so as to create a comfortable working environment.

2.2. Working Environment

Humans and the environment are interdependent entities. Humans must be able to adapt to the environment, including the work environment. The condition of the working environment affects the physical and psychological conditions of workers and directly impacts the performance results. In the work system, humans are as controllers, planners, as well as interacting with the system. In creating a comfortable working environment, several aspects must be considered, namely differences in physical, psychological conditions, as well as the strengths and weaknesses of people who are in the work system. According to [6], the strengths and weaknesses of human physical condition are indeed the main things, but not only factors that can affect work productivity.

There are several things that must be considered in the work environment, including noise, light intensity, temperature, and others. Employees can work optimally if the working environment is suitable. Conversely, improper environmental conditions will impact on employees within a certain period of time. A further impact is the occurrence of work accidents [7].

One part of the work environment that affects workers is temperature. High temperatures are dangerous in the work environment [8]. Other research states that high temperatures can reduce performance because it affects the human psychological system [2].

2.3. Two-Way Analysis of Variance (Two-Way ANOVA)

The experimental design is used to obtain an appropriate sample for the population in the study conducted, then the corresponding conclusions are obtained [9]. The analysis used in experimental design is Analysis of Variance (ANOVA) which examines the influence or contribution of factors to the response. One type of ANOVA is the Two-Way ANOVA which is used if the experiment involves two factors, and a combination of levels between factors [10] is carried out. The mathematical model used in the design of this experiment is as follows.

$$Y_{ijk} = \mu + \tau_{ij} + \varepsilon_{k(ij)} \tag{1}$$

where:

i : level of Factor A

j : level of Factor B

τ_{ij} : effects caused by the treatment

$\varepsilon_{k(ij)}$: error in each treatment

The hypothesis used in ANOVA is

H_0 : $\mu_1 = \mu_2 = \cdots = \mu_n$

H_1 : there is at least one different μ_i

The decision to reject H0 if the value $F > F_{table}$, and if the decision use p.value then H_0 is rejected where $p.value < \alpha$.

3. Data and Methods

In this study, the experimental unit was a student who measured 25 workpieces. The response variable is the result of measuring the length and diameter of the workpiece parts (six parts) as Figure 1.

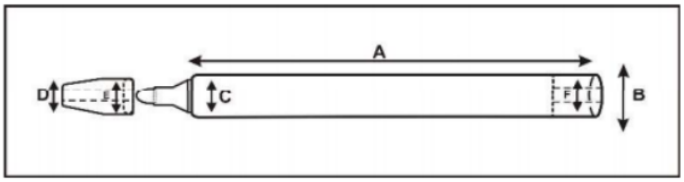

Figure 1. Measured workpiece

Part A is the length of workpiece, then part B to F are the diameter of workpiece. The independent variable or factors that influence the response variable are temperature and the measuring instrument used by student in measuring workpieces. The temperature factor has 2 levels and the measuring instruments has 5 levels. The level for each factor as follows.

Table 1. Factor and level for experiment

Factor	Symbol	Level	Symbol
Temperature	Q	AC	Q1
		Non-AC	Q2
Measurement Instruments	P	Vernier Calliper	P1
		Vernier Calliper Digital	P2
		Mistar	P3
		Micrometer Screw	P4
		Micrometer Screw Digital	P5

The experimental design used was Two Way Analysis of Variance (Two-Way ANOVA) involving two factor and its interaction. The data structure as follows.

Table 2. Data Structure

Temperature	P1	P2	P3	P4	P5
Q1	x_{111}	x_{112}	x_{113}	x_{114}	x_{115}
	x_{211}	x_{212}	x_{213}	x_{214}	x_{215}
	x_{311}	x_{312}	x_{313}	x_{314}	x_{315}
	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
	x_{2511}	x_{2512}	x_{2513}	x_{2514}	x_{2515}
Q2	x_{121}	x_{122}	x_{123}	x_{124}	x_{125}
	x_{221}	x_{222}	x_{223}	x_{224}	x_{225}
	x_{321}	x_{322}	x_{323}	x_{324}	x_{325}
	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
	x_{2521}	x_{2522}	x_{2523}	x_{2524}	x_{2525}

The method carried out in this paper is as follows.

- do data retrieval by measuring 25 workpieces repeatedly using five measuring instruments,

- workpiece measurements are carried out in two different conditions, the first condition use Air Conditioner (AC) and the second condition does not use,
- the parts of workpiece are measured according to Figure 1,
- after the data is collected, an analysis is conducted using Two Way ANOVA to see whether differences in the use of measuring instruments and AC affect the measurement results,

4. Results and Discussion

In this paper, the statistical method used Two-Way ANOVA. The hypotheses are tested based on factors are thought to influence the measurement results are as follows.

$H0_1$: Temperature does not significantly influence the measurement results of the workpiece
$H0_2$: Measurement instrument does not significantly influence the measurement results of the workpiece
$H0_3$: Interaction between temperature and measurement instrument does not significantly influence the measurement results of the workpiece
$H1_1$: Temperature does significantly influence the measurement results of the workpiece
$H1_2$: Measurement instrument does significantly influence the measurement results of the workpiece
$H1_3$: Interaction between temperature and measurement instrument does significantly influence the measurement results of the workpiece

The results of data analysis are shown as follows.

Table 3. The results of statistical test for each part of workpiece

Part	df	Sum of Sq.	Mean Sq.	F-ratio	P-value
A (length)					
Q	1	334.75	334.75	3774.75	0.00
P	4	400.27	100.07	1128.38	0.00
Q*P	4	374.52	93.63	1055.79	0.00
Error	240	21.28	0.09		
Total	249	1130.82			
B (diameter)					
Q	1	4.38	4.38	27.42	0.00
P	4	48.50	12.12	75.95	0.00
Q*P	4	38.32	9.58	60.02	0.00
Error	240	38.31	0.16		
Total	249	129.51			
C(diameter)					
Q	1	0.37	0.37	17.08	0.00
P	4	1.97	0.49	23.00	0.00
Q*P	4	0.86	0.21	10.03	0.00
Error	240	5.14	0.02		
Total	249	8.34			
D(diameter)					
Q	1	368375	368375	1	0.32
P	4	1476599	369150	1	0.41
Q*P	4	1473576	368394	1	0.41
Error	240	88443951	368516		

Journal of Physics: Conference Series **1381** (2019) 012061 doi:10.1088/1742-6596/1381/1/012061

Part	df	Sum of Sq.	Mean Sq.	F-ratio	P-value
Total	249	91762501			
E(diameter)					
Q	1	2.21	2.21	88.14	0.00
P	4	8.64	2.16	86.12	0.00
Q*P	4	4.38	1.10	43.65	0.00
Error	240	6.02	0.03		
Total	249	21.25			
F(diameter)					
Q	1	652450	652450	1.01	0.316
P	4	2592270	648067	1	0.406
Q*P	4	2571957	642989	1	0.41
Error	240	154772911	644887		
Total	249	160589588			

The decision to reject or accept H0 is based on F value or the significance of p-value. Hypotheseis H0 is rejected if the $F > F_{tabel}$, where the determination of F dan F_{tabel} is based on degrees of freedom of factor 1 and factor 2. If using the p-value significance, H0 will be rejected when the $p - value < \alpha$, in this case use α 5%. Based on Table 3, all parts of the workpiece measured show temperature, measuring devices, and their interactions significantly affect the measurement results, except for measurements of diameters D and F, because in both parts p-value> α. If you look further, the SS error value in D and F is very large compared to other parts, thus affecting the significance test of these two factors. In addition to factor 1 and factor 2, there are also significant interactions affecting differences in measurement results, then it means that the combination of temperature and measurement instruments used affects simultaneously.

After the ANOVA test, the significant factors in each part of the workpiece are known. Furthermore, the factors calculated contribution value (% contribution) to the measurement results in all parts of the workpiece, except parts D and F. The results of the percentage contribution for each factor are as follows.

Table 4 The contribution value for each part of workpiece

Part	df	SS	MS	SS'	% kontribusi	R^2 (%)
A (length)						
Q	1	334.75	334.75	334.66	29.59	98.05
P	4	400.27	100.07	399.91	35.36	
Q*P	4	374.52	93.63	374.16	33.09	
Error	240	21.28	0.09			
Total	249	1130.82				
B (diameter)						
Q	1	4.38	4.38	4.22	3.26	69.31
P	4	48.5	12.12	47.86	36.95	
Q*P	4	38.32	9.58	37.68	29.09	
Error	240	38.31	0.16			
Total	249	129.51				

Journal of Physics: Conference Series **1381** (2019) 012061 doi:10.1088/1742-6596/1381/1/012061

C(diameter)						
Q	1	0.37	0.37	0.35	4.20	36.21
P	4	1.97	0.49	1.89	22.66	
Q*P	4	0.86	0.21	0.78	9.35	
Error	240	5.14	0.02			
Total	249	8.34				
E(diameter)						
Q	1	2.21	2.21	2.18	10.26	70.40
P	4	8.64	2.16	8.52	40.09	
Q*P	4	4.38	1.1	4.26	20.05	
Error	240	6.02	0.03			
Total	249	21.25				

Based on Table 4, it can be seen each factor and the interaction between factors contribute differently to each part is measured. And the result is the difference factor of the measuring instrument used gives the highest contribution to the difference in measurement results. Temperature contributes an average of 11.83% to differences in measurement results, measuring instruments contribute an average of 33.77% and interactions between temperature and measuring instruments contribute 22.90%. The smaller percentage of temperature contribution from the measuring instrument is caused by the number of treatments used in the experiment. The temperature used only distinguishes measurements in the AC and Non-AC rooms without the room temperature being measured, so the measurement results obtained do not provide a large difference. The second factor, namely measuring instruments contribute above 30% to the measurement results because the types of measuring instruments used are different so that the accuracy provided is also different.

Temperature and type of measuring instrument used have a significant effect on the measurement results, which on a larger scale affect to quality control. This quality control determines the products received or rejected so that high accuracy is needed because it is related to production results.
Based on the analysis of the measurement results, the largest R ^ 2 values are part A almost 100%, part B and E are below 75%, and part C is below 50%. If the value of R ^ 2 is small, it means that there are other factors outside of the observation that have a large influence on the measurement results. For example in part C, the value of R ^ 2 is only 36.21%, then it means temperature, measuring instruments, and their interactions only contribute 36.21% to the measurement results, while 63.79% is influenced by factors other than these two factors, for example the physical conditions who take measurements.

5. Conclusion

The temperature affects the measurement results, but the contribution percentage is smaller than the type of measuring instrument used. It is caused by temperature settings that only use and do not use AC (not specifically regulated at certain temperatures). In the next research can be developed by specifically setting the temperature (using more than two levels) so that the effect given to the measurement results is clearer and reduces errors.

References

[1] Ali A S, Chua S J L and Lim M E L 2015 The effect of physical environment comfort on employees' performance in office buildings: A case study of three public universities in Malaysia *Struct. Surv.*

[2] Badayai A R A 2012 A Theoretical Framework and Analytical Discussion on Uncongenial Physical Workplace Environment and Job Performance among Workers in Industrial Sectors *Procedia - Soc. Behav. Sci.* **42** 486–95

[3] Seppänen O, Fisk W and Lei Q 2006 Effect of Temperature on Task Performance in Office Environment *Lawrence Berkeley Natl. Lab.* 11

[4] Febriyanti Y 2007 *ANALISIS PENGARUH TEMPERATUR DAN KEBISINGAN TERHADAP KERJA SISTEM CARDIOVASCULAR OPERATOR PRODUKSI (Studi Kasus PT General Electric Lighting Indonesia)* (Universitas Sebelas Maret Surakarta)
[5] Wignjosoebroto 2012 Ergonomi, studi gerak dan waktu : teknik analisis untuk peningkatan produktivitas kerja *Univ. Sumatera Utara Libr.*
[6] Kroemer A D and Kroemer K H E 2016 *Office ergonomics: Ease and efficiency at work: Second edition* (New Jersey: Prentice International Hall, Inc)
[7] Yildizel S A, Kaplan G, Arslan Y, Yildirim and Ozturk A U 2015 A study on the effects of weather conditions on the worker health and performance in a construction site **4** 291–5
[8] Monazzam M R, Golbabaei F, Hematjo R, Hosseini M and Dehghan S F 2006 The Assessment of Heat Stress and Heat Strain in Pardis Petrochemical Complex, Tehran, Iran **5** 6–11
[9] Walpole R, Myers R, Myers S and Ye K 2012 *Probability & Statistics for Engineers & Scientists* (London: Pearson Prentice Hall)
[10] Montgomery D C 2012 *Design and Analysis of Experiments Eighth Edition* (New York: John Wiley & Sons Inc.)

Turnitin Journalofphysics

ORIGINALITY REPORT

13%	10%	9%	11%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to SVKM International School Student Paper	6%
2	doi.org Internet Source	2%
3	Y. Sun, D. Ma, P. Schulze Lammers, O. Schmittmann, M. Rose. "On-the-go measurement of soil water content and mechanical resistance by a combined horizontal penetrometer", Soil and Tillage Research, 2006 Publication	2%
4	eprints.umm.ac.id Internet Source	1%
5	online.agris.cz Internet Source	1%
6	Ria Budi Sundoro, Kohar Sulistyadi, Syahfirin Abdulla. "Strategic of Implementation of Ergonomic Positions for Nurses in Healthcare Department with SAST and AHP Methods in	1%

Qatar", International Journal of TROPICAL DISEASE & Health, 2019

Publication

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		