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Ergonomic design for laptop desk in sit-down cafe with hotspot

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Abstract. This study aims to design laptop desk in sit-down cafe with hotspot availability, which are ergonomic and comfortable for consumers, so that they will feel comfortable to put their laptops, food and drinks. Therefore, the initial research was conducted to find the criteria which the customers require regarding laptop desk in sit-down restaurant with hotspot availability by distributing questionnaires to consumers which was then followed by validity and reliability test toward the questionnaires which was then followed by the weighting using AHP method. After obtaining the criteria of the required desk, then a morphological map was created to get the alternative design in accordance with the criteria required by consumers. After that, zero-one calculation was performed to get the required/selected design. Anthropometry was then calculated to get the actual size/dimension. Based on the results of the study it can be concluded that the selected design based on the customers' preference is a laptop desk designed for individuals / personal equipped with a place/space to eat and drink with a brown color, made from wood and with the size / dimensions: Table length = 56 cm, table width = 34 cm, table height = 36 cm.

1. Introduction

In the past, cafes were only used as a place to drink coffee or enjoy food in a relaxed atmosphere. Along with the development of the era, cafes also adjust themselves by providing internet facilities which is commonly called a hotspot area. We often find tables at *lesehan* cafes with hotspot area that are not ergonomic to put food, drink and laptop. This is the same as table that does not have a special place to put a laptop, drink or food that makes it rather difficult for the users to put food/drink as seen in figure 1.



Figure 1. Table at a cafe with hotspot.



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From Figure 1 it can be seen that the consumer must hold the plate or bowl of food because there is no special place to put the bowl or plate.

Based on the result of the initial questionnaire distributed to respondents, it was found that consumers felt less comfortable with the current laptop desk. The consumers often find it difficult to put their laptop and drink on the laptop desk. That is why they feel uncomfortable. According to Hutabarat et al [1] an uncomfortable situation will lower mood and have a negative impact on perception. Thus, consumers need additional space to put food/drink on the laptop desk with a table designed for individuals. From the result of the study Hutabarat et al [2] it is stated that a comfortable environment will make mental workload will be lower [3] which can decrease stress level and make people more relaxed because the body does not get tired quickly. This causes consumers to be less comfortable using laptops while enjoying the food and drinks available. Therefore, this study will emphasize on the ergonomics aspect to achieve qualified and certified design, which is suitable with customer needs. As the previous research were merely about the functional aspect [3], in this research, beside the functional aspect, the study also considered aesthetic, and practical aspects to provide comfort to the users of the product.

2. Research methods

2.1. Data collection

The methods of data collection used in this study are:

2.1.1. Field research. Field research is a way to obtain data by observing an object being studied. The techniques used are observation, interview, documentation, and questionnaires.

2.1.2. Literature study. This method concerns with review of literature in which the researcher obtains all materials related to the theoretical basis contained in the literature.

2.2. Data processing methods

The data processing methods used in this study are:

2.2.1. Determining the number of samples. Determination of the number of samples is done to find out the minimum number of objects or respondents that must be observed in the research.

2.2.2. Data sufficiency test and data uniformity test. Data sufficiency test shows whether the amount of data to be examined is sufficient or not. The amount of data is said to be sufficient (adequate) if $N' < N$ and if $N' > N$ it is necessary to perform re-measurement.

2.2.3. Determining product criteria. Product criteria can be obtained by distributing questionnaires so that the criteria set are in accordance with the expectations and customer needs.

2.2.4. Validity and reliability test. Validity is a measure that shows the levels of validity of an instrument. If: $r \text{ count} > \text{than } r \text{ table}$, the questionnaire is said to be valid. On the contrary, if $r \text{ count} < \text{than } r \text{ table}$, the questionnaire is said to be invalid.

Reliability refers to a sense that something is trustworthy to be used as a data collection tool because the instrument is already good. Reliability Test is done using SPSS for Windows version 14.0 in the correlation procedure using the Alpha Cronbach method. The criteria in this test are the smaller the measurement error, the more realistic the measuring instrument.

2.2.5. Determining the desired design alternatives. Determination of desired design alternatives is carried out by using zero-one matrix morphology map and evaluation matrix.

2.2.6. Designing the selected product. The product is designed with an ergonomic approach, namely by using body's anthropometry approach so that the dimensions of the product are in accordance with the dimensions of the user's body with the purpose that the product design fulfils the ergonomic aspect.

3. Results and discussion

3.1. Number of samples

Of the 94 questionnaires distributed, 2 questionnaires were invalid because the answer was incomplete. Based on Bernoulli's formula, the minimum number of samples required is:

$$n \geq \frac{1,96^2 \left(\frac{92}{94} \right) \left(\frac{2}{94} \right)}{0,1^2}$$

$$\geq 7,99 \approx 8$$

So, the minimum number of samples required is 8 respondents.

3.2. Validity test

If the value in the Corrected Item Total Correlation column is positive and is greater than r-table (0.207), the data is declared to be valid. Reliability test is performed using the SPSS program (Statistical Social Science Program) version 14.0 for Window

Table 1. The results of validity test analysis.

	Corrected Item-total correlation Value (r-count)	Critical Value (r-table)	Conclusion
Question 1	.339	.207	Valid
Question 2	.445	.207	Valid
Question 3	.258	.207	Valid
Question 4	.465	.207	Valid
Question 5	.397	.207	Valid
Question 6	.425	.207	Valid
Question 7	.336	.207	Valid
Question 8	.570	.207	Valid

3.3. Reliability test

Reliability of a questionnaire is said to be good if the Cronbach's Alpha value is > 0.60. Reliability test is done using the SPSS program (Statistical Social Science Program) version 14.0 for Windows.

Table 2. Reliability test results.

Cronbach's Alpha	N of Items
.709	8

3.4. Weighting criteria with analytic hierarchy process (AHP)

From the results of data processing, weighting criteria are obtained as follows:

Table 3. The results of weighting criteria.

Criteria	Weight	Weight (%)
Comfortable	0.45	45
Personal	0.26	26
Practical	0.16	16
Aesthetic	0.13	13

3.5. Morphological map

To get morphological criteria, a questionnaire was provided to find out the criteria in a design of laptop table desired by the consumers. From the results of the questionnaire distributed to 94 respondents, it can be concluded that the 5 criteria desired by consumers in the design of laptop table in a *lesehan* cafe with hotspot area are, among others: suitable with human's anthropometry, shape, color, material, and additional functions.

Table 4. Morphological maps.

Kriteria	Item				
Suitable with anthropometry	Antropometric				
Design	A	B	C	D	E
Color	Brown	White	Black		
Material	Wood				
Additional Function	Specific place for food and drink and laptop				

From the morphological map, there are several alternatives of the design of laptop table for *lesehan* cafe with hotspot area, namely:

Alternative design = (Anthropometric) x (Design) x (Color) x (Material) x (Additional Function) = $1 \times 5 \times 3 \times 1 \times 1 = 15$ alternatives

To get a number of alternatives of laptop desk designs that are in accordance with the customers' desire, 15 alternatives are selected by distributing questionnaires to 94 respondents. From the results of the questionnaire, it can be concluded that the 5 selected designs are:

3.5.1. Model A



Figure 2. Model a design.

The design of a laptop desk is equipped with a place for food and drink. The color of the laptop desk is brown and it is made from wood. This design was chosen by 15 respondents.

3.5.2. Model B

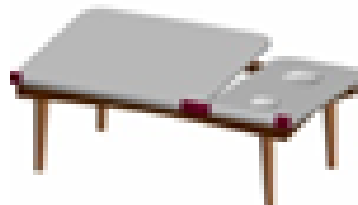


Figure 3. Model B design.

The design of the laptop desk is equipped with a place for food and drink and a space for laptop that can be adjusted. The color is white and it is made from wood. 8 respondents chose this design.

3.5.3. Model C



Figure 4. Model C design

This laptop table is designed with a space for laptop that can be adjusted. It has brown color and is made of wood. It was chosen by 10 respondents.

3.5.4. Model D



Figure 5. Model design D.

Here is the design of a laptop table with a place for food and drink that can be pulled sideways. The color is brown and is made of wood. 9 respondents chose this design.

3.5.5. Model E



Figure 6. Model E design.

The figure shows the design of laptop table with a place for food and drink that can be pulled forward. It has brown color and is made of wood. It was chosen by 8 respondents.

3.6. Zero one matrix and evaluation matrix

The Zero One matrix is used to determine the relativity of a "more important" or "less important" function to other functions. "More important" function is given one mark, while "less important" value is given zero mark. The purpose of using this method is to determine the priority sequence of functions.

3.7. Evaluation matrix

The evaluation matrix is a decision-making tool that is able to combine measurable characteristics and immeasurable characteristics. The following is the calculation of evaluation matrix:

Table 5. The results of evaluation matrix.

Alternatives	Criteria and Weight				Total
	Comfortable (0.45)	Personal (0.26)	Practical (0.16)	Aesthetic (0.13)	
A	0.18	0.156	0.096	0.052	0.484
B	0.27	0.052	0	0.052	0.374
C	0	0.052	0.064	0.026	0.142
D	0	0	0	0	0
E	0	0	0	0	0

From the calculation results of the evaluation matrix, it can be concluded that the most desirable design is design A, namely the design of a laptop table equipped with a place for food and drink.



Figure 7. Selected table design.

3.8. Anthropometric data

3.8.1. Shoulder width anthropometric data

Data Sufficiency Test

If Confidence Level = 95% ($K = 2$); $\alpha = 5\% = 0.05$

$$N' = \left[\frac{K/s \sqrt{N(\sum Xi^2) - (\sum Xi)^2}}{\sum Xi} \right]^2 = \left[\frac{2/0.05 \sqrt{92(158256) - (14516100)}}{3810} \right]^2 = 4.28 \approx 4$$

The data is sufficient because $N' < N$

Table 6. Shoulder width anthropometric data.

no	size	no	size	no	size
1	44	35	42	69	43
2	39	36	41	70	45
3	38	37	39	71	43
4	40	38	38	72	40
5	41	39	38	73	40
6	38	40	42	74	41
7	40	41	40	75	41
8	40	42	41	76	42
9	42	43	39	77	39
10	44	44	45	78	39
11	45	45	41	79	38
12	41	46	42	80	38
13	43	47	43	81	40
14	42	48	41	82	40
15	45	49	42	83	39
16	38	50	43	84	42
17	39	51	42	85	45
18	39	52	40	86	45
19	40	53	40	87	43
20	45	54	41	88	41
21	46	55	41	89	40
22	44	56	43	90	43
23	44	57	39	91	42
24	40	58	39	92	40
25	41	59	40		
26	43	60	38		
27	40	61	41		
28	43	62	42		
29	45	63	43		
30	40	64	44		
31	39	65	43		
32	39	66	43		
33	43	67	44		
34	39	68	45		

3.8.2. Calculation of shoulder width anthropometric data

$$P95 = 44.90 + 1.14 \left[\frac{(95 \times 92) / 100 - 92}{10} \right] = 45.52$$

Using the same method, anthropometry for shoulder width, elbow height in sitting position, forward hand reach, and elbows to the fingertips with percentile 95 is described as follows:

Table 7. Anthropometry data for tables in *lesehan* café.

Shoulder width	45.52 cm
elbow height in sitting position	34.62 cm
forward hand reach	73.51 cm
elbows to the fingertips	44.75 cm

3.8.3. Calculation of dimension

The following result is obtained for the calculation of dimension/size:

Table 8. Dimension of tables in *lesehan* café.

Width of the table	34 cm
Length of the table	56 cm
Height of the table	36 cm

4. Discussion and conclusion

From the results of the questionnaire, the criteria of comfortable, personal, practical and aesthetic are obtained. This illustrates that consumers want the tables at *lesehan* cafe to be multi-function, not only for putting food and drink but can also be used to put a laptop and provide a sense of comfort to interact with the groups. This is reinforced by the results of the study Kim and Hutabarat et al [4,5] which states that a comfortable place to do activities will provide ease of interaction and communication and reduce stress level and mental workload.

The size of the anthropometry and the dimensions for table design at *lesehan* cafe are the measurements which are obtained based on the suitability of the size of respondent's anthropometry and adjusted to the needs of the customers' activities while they are at the table. The purpose is that customers feel comfortable and they do not feel sore due to size of the table, as stated by Chander, Pavlovic-Veselinovic and Nafeesa [6-8] that the design of a workplace that is not ergonomic will pose an uncomfortable risk and can cause injury to the body. If this is ignored without any solution, it will result in negative perception on the place.

This research shows that the functional aspect, the study also considered aesthetic, and practical are needed to be measured to get the appropriate ergonomic design. A design of *lesehan* cafe table which is ergonomic, comfortable and multi-function is needed at *lesehan* cafe, because it will make the customers feel more comfortable, increase positive perception and can reduce stress.

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