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USING ANTHROPOMETRIC DATA TO DESIGN A FORTABLE STUDY DESK AND USER POSTURE ANALYSIS WITH THE RAPPID UPPER LIMB ASSESSMENT (RULA) METHOD

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Abstract: The use portable study desk that is designed to be easy moved still make complaints in muscles and bones give risk for posture. Design improvements can be based on measurements results of static anthropometric and dynamic anthropometric to identify the risk of posture. The method used in this reaserch is a Rapid Upper Limb Assessment (RULA) method to analyze the risk of posture users of portable study desk, while for the design of study desk using anthropometric data, The purpose of this study was to design a portable study table and analyze the risk posture that occur when users use a portable study desk using the RULA method. The results of study show that design desk study using anthropometric data obtained dimensions of 800 mm in length and 420 mm in width. The table height from the floor to the table surface is 220 mm high. a place to put a D100 mm glass, and there is a place to put a 400 mm cell phone or iPad along with a hole for the cable, there is a Diameter 40 mm. The 2-dimensional and 3-dimensional design process uses Catia software. The results of the Rapid Upper Limb Assessment (RULA) analysis show that the user's posture risk is indicated in green color, which means that there is no posture that needs to be corrected and that posture is acceptable except for the posture muscles (muscles) which are are indicated red color so needed move as soon possible or muscle stretching, this is in line with Osha (2020) who states that static postures are recommended for stretching muscles to avoid muscle fatigue.

Keywords: Desk, Design, Risk, Posture, Anthropometry, RULA.

INTRODUCTION

The Covid-19 pandemic that has hit the whole world has forced each individual to limit social activities including teaching and learning activities, learning activities that are usually carried out at school to be carried out at home to minimize the occurrence of crowds which have an impact on the spread of the Covid-19 virus. A study table is one of the equipment needed at home to facilitate the learning process during a pandemic.

The easy moving from one place to another is an advantage in itself, although its use causes the user to experience a stationary posture for some time without changing position for a while. The use of a study desk causes disturbances in the body because of the risk that posture does not change so that it can cause complaints to the muscles and bones. Complaints about muscle and bone disorders in the body cause complaints in parts of the muscles that are felt mild to severe muscle complaints where severe complaints indicate posture is out of safe condition and immediate repair is needed.

Improvement work design can be done based on the results of measurements anthropometric data which are divided into static anthropometry and dynamic anthropometry. Static measurements are carried out when the body is in a still state, while dynamic measurements measure movements that may occur during activities so that the risk of posture can be identified.

Rula (Rappid Upper Limb Assessment) is a tool can use to evaluate posture risk that can be done after designing using the catia application, RULA indicates posture risk in the form of numbers and color output results with Ergonomics Design & Analysis in Human Activity Analysis. This study aims to design a portable study table and analyze the risk factors for posture that occur when users use a portable study desk using the RULA method.

RESEARCH METHOD

This research method is carried out by direct observation of the user when the user uses a study desk. Direct observation is carried out to collect primary data in the form of:

1. Anthropometric data for design a study desk
2. User posture data when using a study desk move

Anthropometric data is used to determine dimensions of a comfortable study desk to be designed. The user's posture data used to analyze the risk of posture that occurs from using the pertoble desk using the Rapid Upper Limb Assessment (RULA) method where the analysis results will indicate a certain color level as shown in the following table:

Tabel 1. Risk Level Of RULA

Skor	Risk Level	Information
1 – 2	Minimum	Safe
3 – 4	Small	Need take improvement in some time
5 - 6	Medium	Need take action for improvment
7	Tinggi	Urgent repair needed

RESULT AND DISCUSSION

Anthropometric data used for design of a portable study desk include the length of the elbow span, the length of the forearm, the width of the hand and the height of the elbow in a sitting position where the measurement results showing in the following table:

Table 2. Antropometri Data For Design Of a Portable Study Desk

No.	length of the elbow span **(PRS)**	length of the forearm **(PLB)**	width of the hand **(TL)**	height of the elbow in a sitting position **(TSPD)**
1	79	41	9,5	25
2	77	39	8,5	23
3	78	40	9	24
4	76	38	8	22
5	76,5	38,5	8,2	22,5
6	76	38	8	22
7	78	40	9	24
8	79	41	9,5	25
9	77	39	8,5	23
10	76	38	8	22
11	77,5	39,5	9	23,5
12	77,5	39,5	9	23,5
13	78	40	9	24
14	77,5	39,5	8,8	23,5
15	79,5	41,5	9,5	25,5
16	78,5	40	9	24,5
17	77	39,5	8,5	23
18	78	40	8	24

No.	length of the elbow span **(PRS)**	length of the forearm **(PLB)**	width of the hand **(TL)**	height of the elbow in a sitting position **(TSPD)**
19	77,5	39,5	9	23,5
20	76	38	8	22
21	77	39	8,5	23
22	79,5	41,5	9,5	25,5
23	77	39	8,5	23
24	78	40	9	24
25	78,5	40,5	9	24,5

After obtaining anthropometric data measurements, then determine the percentages that will be used in the design of portable study tables, namely the 5th, 50th and 95th percentiles. This determination of percentile is determined with the consideration that this percentile can accommodate the 5th, 50th or 95th percentile data, so that the population can be served, table 3 below shows the results of the percentage calculation:

Tabel 3. Percentage Calculation

Persentil	**Calculation**
1-St	$\bar{x}$ - 2,325 . s
2,5-th	$\bar{x}$ - 1,96 . s
5-th	$\bar{x}$ - 1,645 . s
10-th	$\bar{x}$ - 1,28 . s
50-th	$\bar{x}$
90-th	$\bar{x}$ + 1,28 . s
95-th	$\bar{x}$ + 1,645 . σ
97,5-th	$\bar{x}$ + 1,96 . σ
99-th	$\bar{x}$ + 2,325 . σ

Anthropometric body sizes are calculated as a persentil value for the length of the elbow span as follows :

P5 = 77,58 – (1,645 . 1,05) = 75,85
P50 = 77,58
P95 = 77,58 + (1,645 . 1,05) = 79,31

a. The percentile calculation for forearm length is as follows:
   P5 = 39,58 – (1,645 . 1,05) = 37,85
   P50 = 39,58
   P95 = 39,58 + (1,645 . 1,05) = 41,31

b. The Calculation of percentiles for hand width as follows:
   P5 = 8,74 – (1,645 . 0,51) = 7,90
   P50 = 8,74
   P95 = 8,74 + (1,645 . 0,51) = 9,58

c. The Calculation of percentiles for elbow height in a sitting position is as follows:
   P5 = 23,58 – (1,645 . 1,05) = 21,85
   P50 = 23,58
   P95 = 23,58 + (1,645 . 1.05) = 25,31

The recapitulation of percentile calculation results is shown in Table 4.4 Summary of Anthropometric Data Percentile Calculation Results.

Table 4. Summary of Anthropometric Data Percentile Calculation Results.

No.	Measured Anthropometric Data	Symbol	Avarage	St.deviasi	P5	P50	P95
1	length of the elbow span	PRS	77,58	1,05	75,85	77,58	79,31
2	Lower Arm Length	PLB	39,58	1,05	37,85	39,58	41,31
3	Hand Width	LT	8,74	8,74	7,9	8,74	9,58
4	Elbow height in sitting position	TSPD	23,58	23,58	21,58	23,58	25,31

Anthropometric data sizes for study table users consisting of forearm length, elbow span length, hand width and elbow height in a sitting position are used to design portable study desk which will be analyzed using the RULA method in CATIA V5 software. Design result portable study desk products based measurement antropometri data using CATIA V5 software as shown in the following figure:

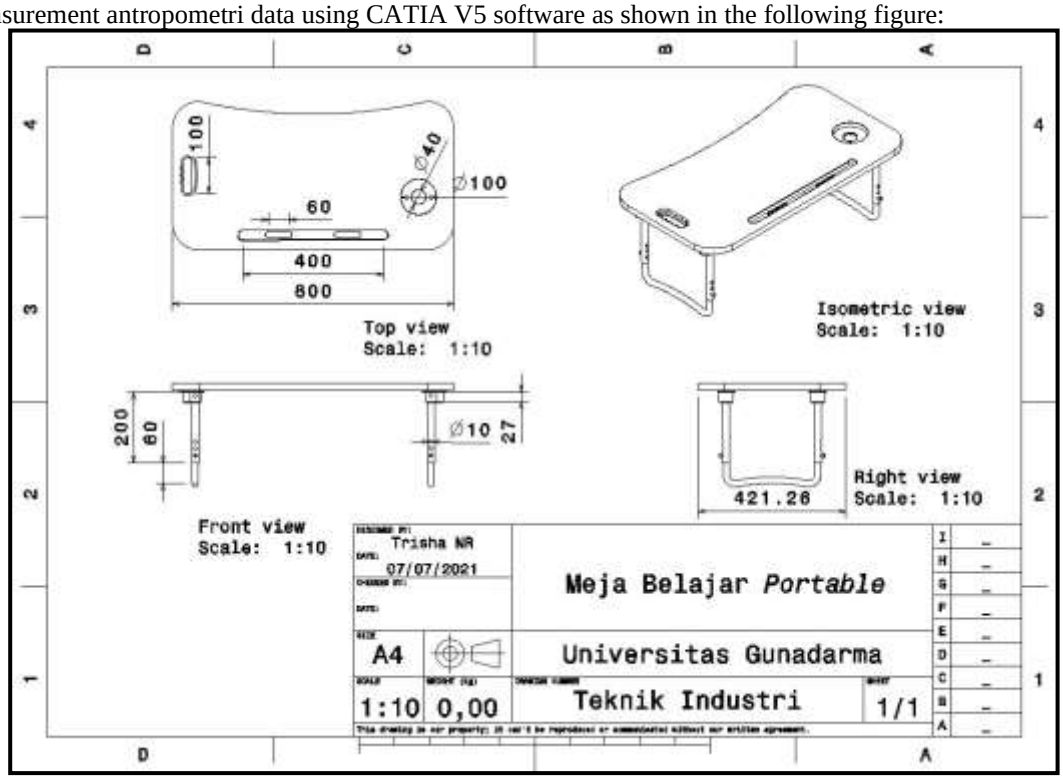

Figure 1. *Desain* Portable Desk Study

Based on the picture above, the design for portable study table products based on the of anthropometric data processing obtained desk dimensions as shown in the following table:

Tabel 5. Desk Dimensions Fortable

No.	Dimensions	Size
1	Desk Length	800 mm
2	Desk Width	420 mm
3	Desk height from floor to table top	220 mm.
4	A place to put glasses	D100 mm
5	A place to put cell phones and ipads	400 mm
6	Holes for cables	D40 mm

The visualization of the 3D Portable Study desk Product design using CATIA software is shown in the following figure:

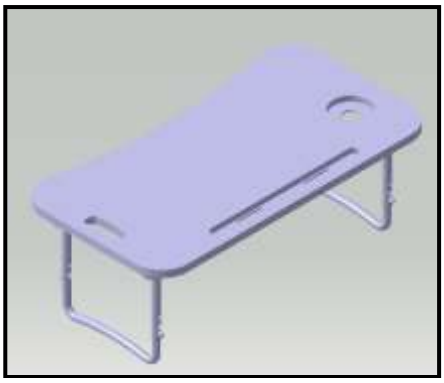

Figure 2. Portable Study desk Product design using CATIA

Based result of desaign, a posture simulation is user using a portable study desk represented by a mannequin to facilitate simulation of risk posture analysis by using the Rapid Upper Limb Assessment (RULA) in CATIA V5 software to facilitate simulation, the mannequin is arranged in a sitting position to resemble the user as shown in the following figure:

Figure 3. Mannequin Position For Simulation Risk Posture User of a Fortable Study Desk

The mannequin that has been set to follow the user's posture will then be analyzed for its posture risk using the RULA method where the results of the RULA Method Analysis of Using a Portable Study Table are shown as follows:

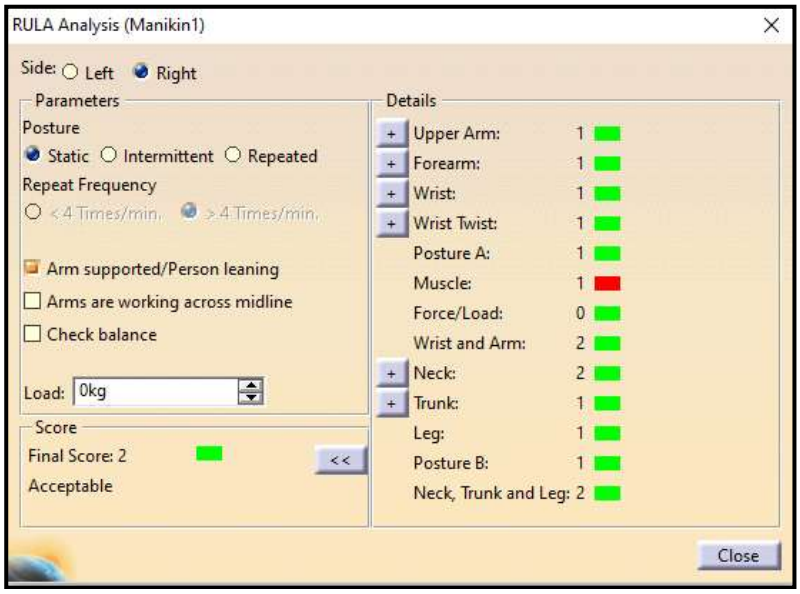

Figure 4. Results of Analysis Risk Posture User Fortable Study Desk With RULA Method

The results of RULA analysis show that the body parts of group a (posture a) are indicated in green color, with body details namely upper arm, forearm, wrist and wrist twist indicated in green color. with each having a score of 1 which means there is no posture that needs to be corrected and the posture is acceptable. The body parts of group b (posture b) are indicated in green color with detailed body parts namely the neck, trunk and legs indicated in green which means there is no posture that needs to be corrected and the posture is acceptable. Details other values which attached to the simulation results, namely force/load, get a green color indication because there is no load or force related to the user. Muscles (muscles) get a red color indication so is a need change of posture as soon as possible, this is likely due to a static position or no movement, therefore muscle or musculoskeletal fatigue occurs. According to Osha (2020), postures that are done statically are recommended for stretching the muscles to avoid muscle fatigue due to a static position.

CONCLUSION AND SUGGESTIONS

Design of a portable study desk using anthropometric data result obtained dimensions of 800 mm in length and 420 mm in width. The table height from the floor to the table surface is 220 mm high. a place to put a D100 mm glass, and there is a place to put a 400 mm cell phone or iPad along with a hole for the cable, there is a D40. The 2-dimensional and 3-dimensional design process uses Catia software.

Results of Rapid Upper Limb Assessment (RULA) analysis show that the user's posture risk is indicated in green color, which means that there is no posture that needs to be corrected and that posture is acceptable except for the posture muscles (muscles) which are indicated red color so needed move as soon possible or muscle stretching. this is in line with Osha (2020) who states that static postures are recommended for stretching muscles to avoid muscle fatigue

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