

LAMPIRAN:

Surat Keterangan pihak Sekolah tentang hasil Desain Kursi Belajar Ergonomis



SEKOLAH MENENGAH KEJURUAN
BRANTAS KARANGKATES

STATUS : TERAKREDITASI "A"

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Nomor : 3219/I04.4/SMK BRT/I.01/VII/2020 Sumberpucung, 09 Juli 2020
Lampiran : -
Perihal : **Surat Keterangan**

Kepada,
Yth. : Waka. Sarana dan Prasarana
SMK Brantas Karangates

Di Tempat

Dengan hormat,

Dalam rangka untuk memenuhi kebutuhan Sarana dan Prasarana terutama untuk sarana pembelajaran di SMK Brantas Karangates Sumberpucung Kabupaten Malang, maka kami sampaikan bahwa kursi pembelajaran yang didesain oleh saudara :

Nama : Didik Wargiono, ST.
Jabatan : Guru Produktif Teknik Mesin

Spesifikasinya sesuai dan sangat berguna untuk proses pembelajaran dan digunakan di ruang laboratorium komputer SMK Brantas Karangates Sumberpucung Kab. Malang.

Demikian surat keterangan untuk diproses lebih lanjut oleh bagian Sarana Prasarana.



Kompetensi Keahlian :

- | | |
|-------------------------------------|-----------------------------|
| 1. Teknik Instalasi Tenaga Listrik | 6. Rekayasa Perangkat Lunak |
| 2. Teknik Pembangkit Tenaga Listrik | 7. Multimedia |
| 3. Teknik Pemesinan | 8. Tata Boga |
| 4. Teknik Kendaraan Ringan Otomotif | 9. Tata Būšana |
| 5. Teknik dan Bisnis Sepeda Motor | |

Surat-surat/ Surat Keterangan
Tahun pelajaran 2019/2020

Kuisiener Nordic Body Map

DAFTAR KELUHAN *NORDIC BODY MAP*

Nama :

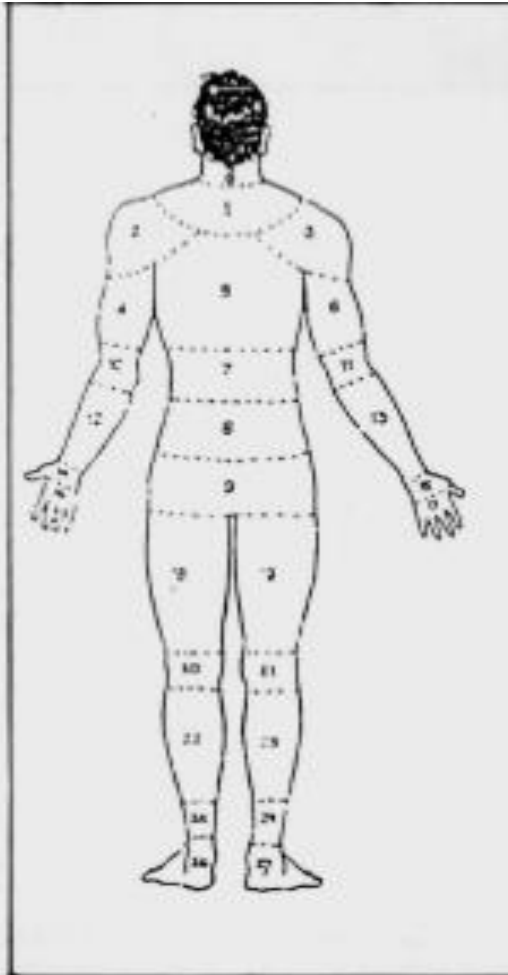
Umur :

Kelas :

Jenis kelamin :

Petunjuk : Beri tanda silang (x) pada kolom yang tersedia sesuai dengan keluhan rasasakit/kaku pada otot yang ananda rasakan.

Ketentuan : A = Sangat sakit B = Sakit
C = Agak Sakit D = Tidak Sakit



No	Jenis Keluhan	Tingkat Keluhan			
		Sebelum Perbaikan			
		A	B	C	D
0	kepala				
1	Leher				
2	Bahu kiri				
3	Bahu kanan				
4	Lengan atas Kiri				
5	Punggung				
6	Lengan Atas Kanan				
7	Pinggang				
9	Bokong				
10	Pantat				
11	Siku kanan				
12	Lengan bawah kiri				
13	Lengan bawah kanan				
14	Pergelangan Tangan kanan				

Hasil Uji Kenormalan Data SPSS 16

```
NPART TEST  
  /CHISQUARE=A B C D E F G  
  /EXPECTED=EQUAL  
  /MISSING ANALYSIS.
```

NPar Tests

[DataSet0]

Chi-Square Test

Frequencies

Lebar Pinggul (LP)

	Observed N	Expected N	Residual
34	8	5.0	3.0
35	4	5.0	-1.0
36	3	5.0	-2.0
38	2	5.0	-3.0
39	7	5.0	2.0
40	5	5.0	.0
42	6	5.0	1.0
Total	35		

Tinggi Popliteal (TP)

	Observed N	Expected N	Residual
37	3	3.9	-.9
38	1	3.9	-2.9
40	7	3.9	3.1
41	4	3.9	.1
42	2	3.9	-1.9
44	8	3.9	4.1
45	4	3.9	.1
46	4	3.9	.1
47	2	3.9	-1.9
Total	35		

Panjang Popliteal (TP)

	Observed N	Expected N	Residual
39	4	4.4	-.4
41	5	4.4	.6
42	1	4.4	-3.4
43	4	4.4	-.4
44	10	4.4	5.6
45	4	4.4	-.4
46	3	4.4	-1.4
48	4	4.4	-.4
Total	35		

Tinggi Bahu Duduk (TBD)

	Observed N	Expected N	Residual
53	7	7.0	.0
54	4	7.0	-3.0
55	8	7.0	1.0
57	11	7.0	4.0
60	5	7.0	-2.0
Total	35		

Tinggi Siku Duduk (TSD)

	Observed N	Expected N	Residual
22	7	5.8	1.2
23	6	5.8	.2
24	9	5.8	3.2
25	3	5.8	-2.8
26	5	5.8	-.8
27	5	5.8	-.8
Total	35		

Siku ke Tangan (ST)

	Observed N	Expected N	Residual
36	12	7.0	5.0
37	7	7.0	.0
38	7	7.0	.0
40	4	7.0	-3.0
42	5	7.0	-2.0
Total	35		

Lebar Bahu (LB)

	Observed N	Expected N	Residual
41	3	4.4	-1.4
42	3	4.4	-1.4
43	6	4.4	1.6
44	7	4.4	2.6
45	3	4.4	-1.4

Lebar Bahu (LB)

	Observed N	Expected N	Residual
46	3	4.4	-1.4
47	6	4.4	1.6
48	4	4.4	-.4
Total	35		

Test Statistics

	Lebar Pinggul (LP)	Tinggi Popliteal (TP)	Panjang Popliteal (TP)	Tinggi Bahu Duduk (TBD)	Tinggi Siku Duduk (TSD)
Chi-Square	5.600 ^a	11.029 ^b	10.486 ^c	4.286 ^d	3.571 ^e
df	6	8	7	4	5
Asymp. Sig.	.469	.200	.163	.369	.613

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

b. 9 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 3.9.

c. 8 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 4.4.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.0.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.8.

Test Statistics

	Siku ke Tangan (ST)	Lebar Bahu (LB)
Chi-Square	5.429 ^d	4.543 ^c
df	4	7
Asymp. Sig.	.246	.716

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

b. 9 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 3.9.

c. 8 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 4.4.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.0.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.8.

Kuisiener Hasil Uji Desain Kursi Belajar

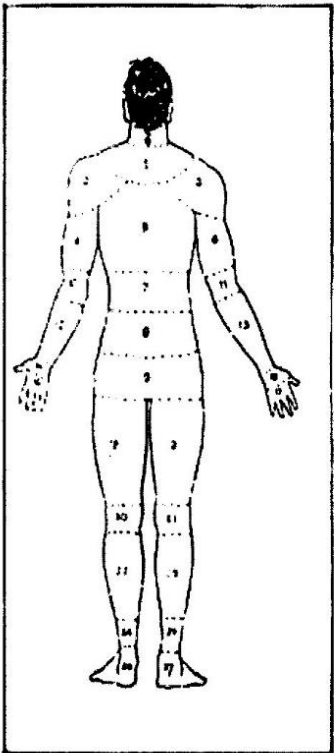
KUESIONER NORDIC BODY MAP

Nama : Ayu Setya Rini
 Umur : 18
 Kelas : XII / TKJ
 Jenis kelamin : Perempuan

Petunjuk : Beri tanda silang (x) pada kolom yang tersedia sesuai dengan keluhan rasasakit/kaku pada otot yang ananda rasakan.

Ketentuan : A = Sangat sakit B = Sakit
 C = Agak Sakit D = Tidak Sakit

No	Bagian tubuh	Jawaban			
		A	B	C	D
0	Leher bagian atas	✓			
1	Leher bagian bawah				
2	Bahu kiri				
3	Bahu kanan				
4	Lengan atas kiri				
5	punggung				
6	Lengan atas kanan				
7	Pinggang				
8	Bokong				
9	Pantat				
10	Siku kiri				
11	Siku kanan				
12	Lengan bawah kiri				
13	Lengan bawah kanan				
14	Pergelangan tangan kiri				
15	Pergelangan tangan kanan				
16	Tangan kiri				
17	Tangan kanan	✓			
18	Paha kiri				
19	Paha kanan				
20	Lutut kiri				
21	Lutut kanan				
22	Betis kiri				




 Ayu S.

KUESIONER NORDIC BODY MAP

Nama : Awong Heru Prasetyo

Umur : 18 th

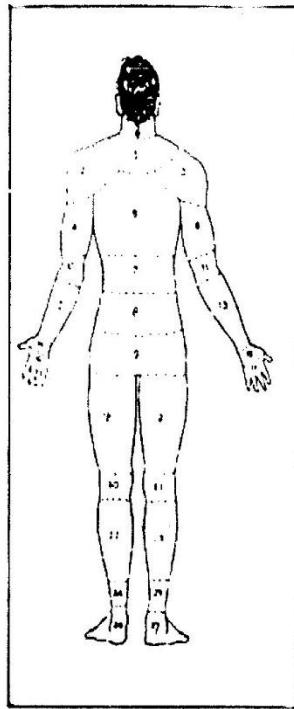
Kelas : XI/TKJ

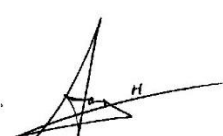
Jenis kelamin : Pria

Petunjuk : Beri tanda silang (x) pada kolom yang tersedia sesuai dengan keluhan rasasakit/kaku pada otot yang ananda rasakan.

Ketentuan : A = Sangat sakit B = Sakit
C = Agak Sakit D = Tidak Sakit

No	Bagian tubuh	Jawaban			
		A	B	C	D
0	Leher bagian atas				
1	Leher bagian bawah				
2	Bahu kiri				
3	Bahu kanan				
4	Lengan atas kiri				
5	punggung				
6	Lengan atas kanan				
7	Pinggang				
8	Bokong				
9	Pantat				
10	Siku kiri				
11	Siku kanan				
12	Lengan bawah kiri				
13	Lengan bawah kanan	✓			
14	Pergelangan tangan kiri				
15	Pergelangan tangan kanan				
16	Tangan kiri				
17	Tangan kanan				
18	Paha kiri				
19	Paha kanan				
20	Lutut kiri				
21	Lutut kanan				
22	Betis kiri				




 Awong H.S.

KUESIONER NORDIC BODY MAP

Nama : **Davina Novelia**

Umur : **18 th**

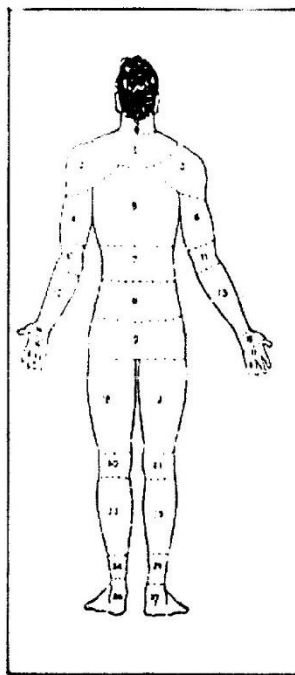
Kelas : **xii / TKJ**

Jenis kelamin : **Perempuan**

Petunjuk : Beri tanda silang (x) pada kolom yang tersedia sesuai dengan keluhan rasasakit/kaku pada otot yang ananda rasakan.

Ketentuan : A = Sangat sakit B = Sakit
C = Agak Sakit D = Tidak Sakit

No	Bagian tubuh	Jawaban			
		A	B	C	D
0	Leher bagian atas				
1	Leher bagian bawah				
2	Bahu kiri				
3	Bahu kanan				
4	Lengan atas kiri				
5	punggung				
6	Lengan atas kanan	✓			
7	Pinggang				
8	Bokong				
9	Pantat				
10	Siku kiri				
11	Siku kanan				
12	Lengan bawah kiri				
13	Lengan bawah kanan				
14	Pergelangan tangan kiri				
15	Pergelangan tangan kanan				
16	Tangan kiri				
17	Tangan kanan				
18	Paha kiri				
19	Paha kanan				
20	Lutut kiri				
21	Lutut kanan				
22	Betis kiri				




 Davina

KUESIONER NORDIC BODY MAP

Nama : Helmi Nur

Umur : 17 th

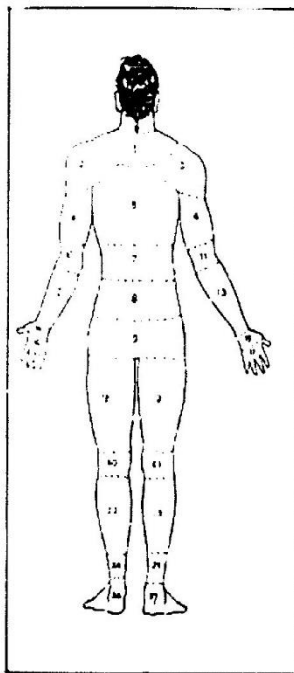
Kelas : XI / TKI

Jenis kelamin : Pria

Petunjuk : Beri tanda silang (x) pada kolom yang tersedia sesuai dengan keluhan rasasakit/kaku pada otot yang ananda rasakan.

Ketentuan : A = Sangat sakit B = Sakit
C = Agak Sakit D = Tidak Sakit

No	Bagian tubuh	Jawaban			
		A	B	C	D
0	Leher bagian atas				
1	Leher bagian bawah				
2	Bahu kiri				
3	Bahu kanan				
4	Lengan atas kiri				
5	punggung	✓			
6	Lengan atas kanan				
7	Pinggang				
8	Bokong				
9	Pantat				
10	Siku kiri				
11	Siku kanan				
12	Lengan bawah kiri				
13	Lengan bawah kanan				
14	Pergelangan tangan kiri				
15	Pergelangan tangan kanan				
16	Tangan kiri				
17	Tangan kanan				
18	Paha kiri				
19	Paha kanan				
20	Lutut kiri				
21	Lutut kanan				
22	Betis kiri				

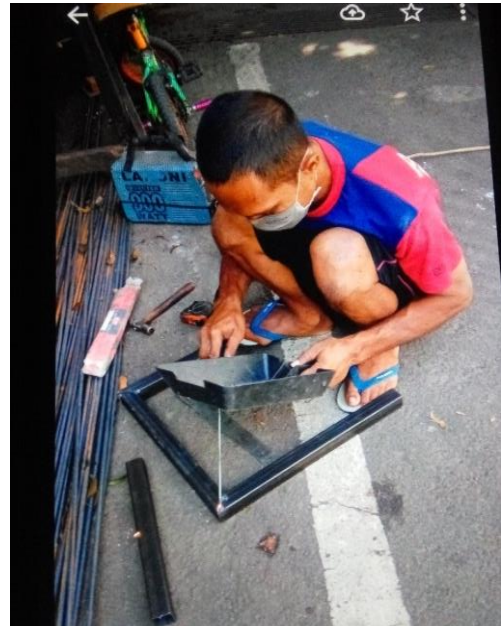


Helmi
Helmi

Foto Proses Pembuatan Desain Kursi Belajar



Gambar Pembuatan Panjang Kursi



Gambar Pembuatan Lebar Kursi



Gambar Pembuatan Sandaran Kursi



Gambar pengecatan



Gambar Pembuatan Meja



Gambar Pembungkusan Busa

Foto Pengukuran Antropometri Siswa



Tinggi Bahu Bahu (TBD)



Lebar Bahu (LB)



Tinggi Popliteal (TP)



Lebar Pinggul (LP)



Panjang Popliteal (PP)



Tinggi Siku Duduk (TSD)



Panjang Siku keTangan (ST)

Foto aktivitas penentuan sudut Kemiringan meja



Gambar Penentuan sudut datar



Gambar penentuan panjang ulir 16 cm



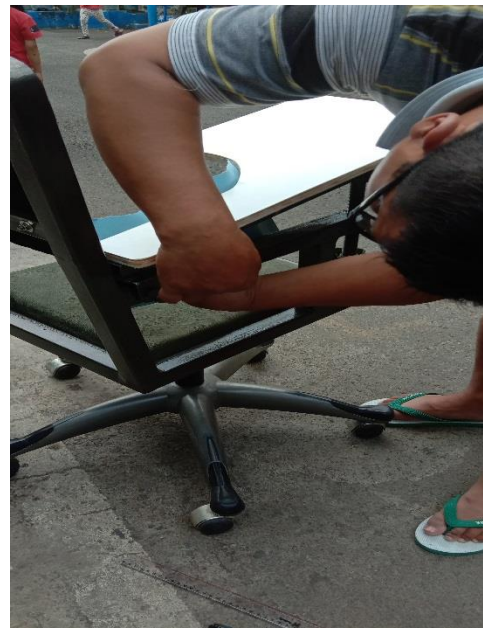
Gambar sudut kemiringan meja Maksimal



Penentuan Sudut Kemiringan Meja



Gambar penentuan panjang ulir 8 cm



Gambar sudut kemiringan meja 8 cm



Penentuan Sudut Kemiringan Meja

DESAIN KURSI MEJA BELAJAR ERGONOMIS UNTUK MENGURANGGI KELUHAN PADA PROSES PEMBELAJARAN

Didik Wargiono¹⁾, Julianus Hutabarat²⁾, Dimas Indra Laksana³⁾

^{1,2,3}Teknik Industri S2 Program Pascasarjana, ITN Malang

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Abstrak

Meja dan kursi belajar adalah fasilitas sekolah yang berpengaruh terhadap postur tubuh siswa, karena postur tubuh akan bekerja secara tidak alami jika menggunakan meja kursi yang tidak ergonomis dikarenakan melalui Observasi penelitian dan pembagian kuisisioner *Nodic Body Map*, didapatkan data adanya keluhan keluhan pada tubuh siswa selama proses pembelajaran di laboratorium komputer SMK Brantas karangkates Malang. Tujuan penelitian ini adalah menghasilkan Desain Kursi Meja Belajar Ergonomis. Metode Penelitian yang digunakan adalah diskriptif dengan pendekatan data antropometri pada 35 siswa yang digunakan dalam data pembuatan kursi meja belajar. Hasil penelitian menghasilkan bentuk kursi belajar yang sesuai dengan Antropometri siswa sehingga dapat meminimalkan keluhan-keluhan *musculoskeletal disorder* dan membuat rasa nyaman dengan memberikan kontribusi pada bentuk meja belajar yang dapat disetel naik turun (*adjustable*) yang membuat pengguna kursi lebih nyaman dalam pelaksanaan proses pembelajaran sesuai hasil kuesioner dengan rata-rata sudut yang digunakan siswa yang disukai siswa adalah 10°.

Kata Kunci : *Observasi, Kuisisioner, Musculoskeletal Disorder, Antrpopometri, Persentil*

Pendahuluan

Sarana dan prasarana kursi dan meja belajar merupakan fasilitas fisik yang sangat penting digunakan dalam melakukan aktivitas belajarsiswa didalam kelas seperti membaca, menggambar, menulis dan kegiatan lainnya. Oleh karena itu sekolah harus menyediakan perabot kelas yang dapat memenuhi kebutuhan siswa [1]. Dengan fenomena yang terjadi di kelas Laboratorium komputer SMK Brantas sebagai berikut:

- a. Dari observasi pada proses pembelajaran di laboratorium komputer, dilihat bentuk tubuh siswa yang tidak ergonomis seperti gambar di bawah ini:



Gambar 1. Suasana Proses Pembelajaran Di Ruang Laboratorium Komputer

- b. Dari hasil pembagian kuisioner kepada 35 siswa dengan ditemukan keluhan-keluhan dari siswa. Rekapitulasi data hasil keluhan-keluhan siswa melalui Kuisioner: keluhan pada leher 100%, pada punggung 85 %, lengan atas kanan 71%, lengan bawah kanan 71% dan tangan kanan 71%.

Ke tidak ergonomisan dengan fenomena yang terjadi itulah yang menjadi latar belakang penelitian ini dan sebagai dasar untuk menyelesaikan permasalahan yang ada dengan hasil bentuk kursi meja belajar ergonomis yang memberikan rasa nyaman pada siswa yang menggunakannya di tambah dengan kontribusi yaitu meja belajar yang bisa disetel naik turun (*adjustable*) yang akan membuat rasa lebih nyaman dengan menetapkan sudut kemiringan dari meja yang sering di minati pada penggunaannya dalam proses pembelajaran di Laboratorium Komputer SMK Brantas Karangates Kabupaten Malang [2].

Metode Penelitian

Penelitian ini menggunakan Metode Diskriptif dengan pendekatan Antropometri pada ke 35 siswa sebagai sampel yang meliputi pengukuran: Lebar Pinggul (LP), Tinggi Popliteal (TP), Pantat Popliteal (PP), Tinggi Bahu Duduk (TBD), Tinggi Siku Duduk (TSD), Siku ke Tangan (ST) dan Lebar Bahu (LB) [3]. Setelah dilakukan pengumpulan data maka langkah selanjutnya adalah menentukan perhitungan persentil dengan tujuan untuk menentukan dimensi desain kursi meja belajar ergonomis. Perhitungan nilai persentil 5, 50 dan 95 dari setiap jenis data yang diperoleh, dilanjutkan dengan perhitungan untuk penentuan ukuran rancangan dan pembuatan rancangan berdasarkan ukuran hasil rancangan. Bentuk hasil rancangan yang telah dibuat dengan kontribusi meja belajar pada desain yang bisa di setel naik turun (*adjustable*) dengan penentuan sudut kemiringan meja yang banyak digunakan siswa akan membuat rasa lebih nyaman pada proses pembelajaran di laboratorium komputer SMK Brantas Karangates Malang.

Hasil dan Pembahasan

Data antropometri yang dikumpulkan dan diolah adalah data yang berhubungan dengan desain kursi meja belajar ergonomis yang disajikan pada tabel berikut:

Tabel 1.Rekapitulasi Data Pengukuran Antropometri Siswa

NO	LP (cm)	TPO (cm)	PP (cm)	TBD (cm)	TSD (cm)	ST (cm)	LB (cm)
1	42	44	48	55	24	36	47
2	42	44	45	54	25	36	41
3	34	45	44	53	26	36	43
4	39	47	46	55	23	36	44
5	39	46	44	53	27	36	42
6	34	45	44	60	24	36	48
7	42	44	41	57	24	36	44
8	40	40	39	57	27	36	44
9	35	44	43	57	26	36	47
10	42	40	48	55	23	36	47
11	36	46	45	54	22	36	48
12	34	46	44	53	22	36	41
13	39	40	46	55	27	37	44
14	39	40	44	53	26	37	45
15	34	37	44	60	25	37	42
16	42	41	41	57	24	37	48

17	40	37	39	57	22	37	43
18	35	42	43	57	23	37	43
19	36	41	45	54	25	37	47
20	42	46	48	55	26	38	46
21	39	40	46	55	22	38	43
22	34	44	44	53	23	38	41
23	34	40	44	60	24	38	42
24	39	44	44	53	26	38	44
25	40	45	39	57	27	38	43
26	42	45	41	57	27	38	48
27	35	47	43	57	23	40	43
28	40	38	39	55	24	40	45
29	38	41	42	54	24	40	47
30	38	41	41	53	22	40	46
31	34	44	45	60	24	42	47
32	34	44	44	60	24	42	46
33	35	42	43	57	23	42	44
34	40	37	41	57	22	42	45
35	39	40	48	55	22	42	44
Σ X	1321	1487	1525	1954	848	1327	1562
ΣXi²	50155	63473	66673	109266	20646	50463	69874

Pengumpulan dan pengolahan Data antropometri bisa mengetahui nilai perhitungan persentil yang akan digunakan sebagai dasar penentuan dari dimensi kursi meja belajar ergonomis dengan memberikan kontribusi dari proses pembuatan yaitu desain meja yang menyatu dengan kursi bisa disetel naik turun (*adjustable*) sesuai kebutuhan. Berikut tabel hasil perhitungan persentil[4]:

Tabel 2 Perhitungan Nilai Persentil

Dimensi Tubuh	Hasil Perhitungan(Cm)				
	X	σ	P5 th	P50 th	P95 th
LebarPinggul (LP)	37,74	2,95	32,88	37,74	42,59
Tinggi Popliteal (TP)	42,49	2,95	37,63	42,49	47,34
Panjang/Pantatpopliteal (PP)	43,57	2,58	39,32	43,57	47,81
Tinggi bahu duduk (TBD)	55,83	2,28	52,07	55,83	59,58
Tinggi siku duduk (TSD)	24,23	1,72	21,40	24,23	27,05
Siku ke Tangan (ST)	37,91	2,11	34,43	37,91	41,38
Lebar Bahu (LB)	44,63	2,20	41,01	44,63	48,25

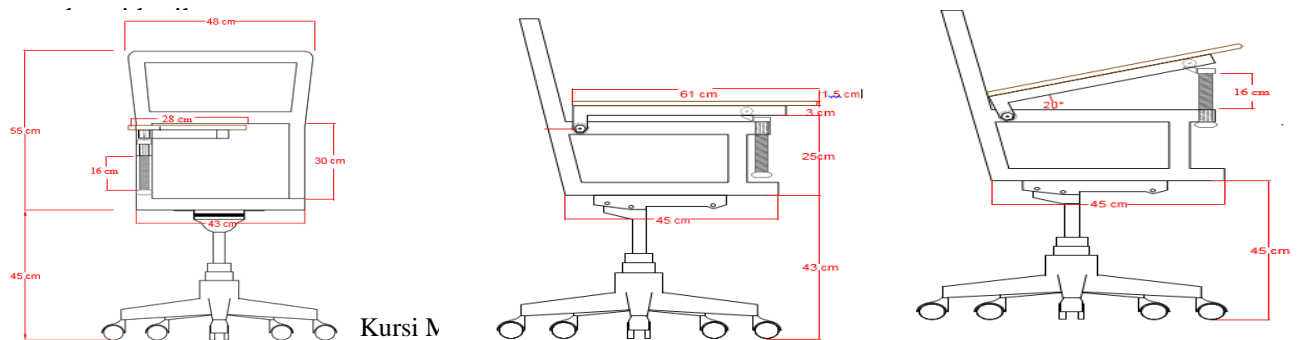
Perancangan Kursi Meja Belajar Ergonomis

Setelah perhitungan persentil diperoleh maka langkah selanjutnya adalah menentukan dimensi kursi yang di tentukan sesuai prosedur berikut ini[4]:

- Dengan tabel perhitungan Persentil di dapatkan untuk penentuan lebar alas duduk menggunakan dimensi tubuh Lebar Pinggul (LP) persentil 95th = 42,59 cm dibulatkan 43cm.
- Dengan tabel perhitungan Persentil didapatkan untuk di dapatkan penentuan tinggi alas kursi adalah menggunakan Tinggi Popliteal (TP) persentil 5th = 37,63 cm di tambah dengan allowance (Penggunaan sepatu) 5 cm jadi total 37,63 + 5 = 42,63 dibulatkan 43 cm.
- Dengan tabel perhitungan Persentil didapatkan untuk penentuan Panjang Alas Kursi menggunakan Panjang/Pantat Popliteal (PP), persentil 5th = 39,32 cm ditambah allowance 6 cm jadi total 39,63 + 6 = 45,32 dibulatkan 45 cm.
- Dengan tabel perhitungan Persentil didapatkan untuk penentuan Tinggi Sandaran Kursi menggunakan Tinggi Bahu Duduk (TBD) menggunakan persentil 50th = 55,83 cm dibulatkan menjadi 56 cm.
- Dengan tabel perhitungan Persentil didapatkan untuk penentuan Tinggi Sandaran Tangan menggunakan Tinggi Siku Duduk (TSD) persentil 50th = 24,23 cm dibulatkan menjadi 25 cm.
- Dengan tabel perhitungan Persentil didapatkan untuk penentuan Panjang meja menggunakan Panjang siku ke tangan (ST) dengan persentil 95th = 41,38 ditambah allowance 20 cm jadi total 41,38 + 20 = 61,38 dibulatkan 61 cm.
- Dengan tabel perhitungan Persentil didapatkan untuk penentuan Lebar Sandaran kursi menggunakan Lebar Bahu (LB) dengan persentil 95th = 48,25 dibulatkan menjadi 48 cm.

Rancangan Kursi Meja Belajar Ergonomis

Desain Rancangan Kursi Meja Belajar Ergonomis dapat digambarkan



Hasil Rancangan Kursi Meja Belajar Ergonomis

Hasil Rancangan Kursi Meja Belajar Ergonomis dapat digambarkan sebagai berikut:



Gambar 3 Hasil Rancangan Kursi Meja Belajar Ergonomis tampak dari depan dan samping

Tabel 3 Perbandingan Kursi meja lama dengan Kursi Belajar Baru

No	Item	Kursi Meja Lama	Kursi Meja Baru
1	Tinggi Alas Kursi	46 cm	43 cm
2	Panjang Alas kursi	45 cm	45 cm
3	Lebar kursi	38 cm	43 cm
4	Tinggi Sandaran Kursi	41 cm	56 cm
5	Lebar Sandaran Kursi	37 cm	48 cm
6	Panjang Meja	65 cm	30 cm & 61 cm
7	Lebar Meja	45 cm	28 cm
8	Tinggi Meja dari Permukaan lantai	73 cm	68 cm
9	Tebal Meja	1,5 cm	2 cm
10	Tinggi Meja pada alas Kursi posisi turun (Kontribusi)	Tidak ada	0 cm
11	Tinggi Meja pada posisi saat dinaikan (Kontribusi)	Tidak Ada	16 cm
12	Sudut Kemiringan Meja	0°	0° → 20°

Dengan menggunakan kuisioner yang diberikan kepada 30 siswa yang dulu digunakan sebagai sampel untuk uji kursi meja belajar aktual dan akan digunakan untuk uji hasil Desain Kursi Meja Belajar Ergonomis, didapatkan hasil pada tabel dibawah ini [5]:

Tabel 4 Bukti Perbandingan Keluhan Hasil Desain Kursi Belajar

No	Keluhan Sakit	Kursi Meja Belajar Lama	Desain Kursi Belajar Baru
1	Leher	35 siswa (100%)	3 siswa (0,085%)
2	Punggung	30 siswa (85%)	4 siswa (0,11%)
3	Lengan Atas Kanan	25 siswa (71%)	4 siswa (0,11)
4	Lengan Bawah Kanan	25 siswa (71%)	5 siswa (0,17%)
5	Tangan Kanan	25 siswa (71%)	7 siswa (0,2%)

Tabel 5 Hasil Kuisioner sudut kemiringan Meja yang di Minati Siswa

Item	0° Jarak ketinggian 0 cm	5° Jarak ketinggian 4 cm	10° Jarak ketinggian 8 cm	15° Jarak ketinggian 12 cm	20° Jarak ketinggian 16 cm
Sudut Kimiringan Meja yang diminati Siswa		√	√	√	
Jumlah siswa		3	30	2	

Kesimpulan

1. Dengan menggunakan kuisioner sebagai metode yang dibagikan kepada 35 siswa dalam uji hasil Desain Kursi Meja Belajar Ergonomis yang telah disesuaikan dengan bentuk antropometri siswa dari hasil uji didapatkan hasil bahwa dalam penggunaan Kursi Meja Belajar hasil rancangan dapat meminimalkan keluhan-keluhan seperti keluhan pada: leher, punggung, lengan atas kanan, lengan

bawah kanan dan tangan kanan dibandingkan ketika memakai kursi meja belajar aktual pada proses pembelajaran di laboratorium komputer SMK Brantas Karangates Malang.

2. Dengan memberikan kontribusi dari bentuk Desain Kursi Meja Belajar Ergonomi yaitu meja belajar yang ada pada kursi. dapat disetel naik turun (*adjustable*) yang membuat lebih nyaman dalam penggunaannya saat proses pembelajaran dengan hasil dari sudut kemiringan meja belajar yang sering digunakan dan disukai pemakaiannya oleh siswa yaitu antara 5° Jarak ketinggian 4 cm sejumlah 3 siswa, 10° Jarak ketinggian 8 cm sejumlah 30 siswa dan 15° Jarak ketinggian 12 cm sejumlah 2 siswa.

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ANALYSIS OF MUSCULOSCELETAL COMPLAINTS DISORDERED WITH REBA METHOD AND RULA METHOD (CASE STUDY OF SMK BRANTAS KARANGKATES MALANG DISTRICT)

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ABSTRACT: Class furniture, namely tables and chairs, are very important physical facilities because the furniture is used for teaching and learning activities, through the distribution of questionnaires and observations carried out at the Computer Laboratory of SMK Brantas Karangates, Malang district to students who as samples obtained the results of complaints from students among them. pain in the neck, waist, right upper arm, right fore arm and right wrist during the learning process due to non-ergonomic facilities. Therefore, the aim of this research is to minimize the complaints of Musculoskeletal Disorder with Ergonomic Learning Chair. In this study, researchers used descriptive research with the REBA method and the RULA method. With the REBA Method and RULA Method approach to detect work posture and investigate upper limb disorders. With the REBA method the final score obtained in Group C is 8, then this value is entered at Action Level 3, after which researchers can only find out that the student's body posture level is in the High category so that action is needed immediately. With the RULA method, the results obtained by the student's body activity are at a Goup C score of 7, then the value is entered for Action Level 4 so that the level of the student's posture is in the dangerous category for safety, health and comfort, therefore action is needed now to overcome this problem with the suggestion. manufacture of Ergonomic Study Chair. From the results of the analysis of the chair use test design results by distributing questionnaires to 35 students as a sample, it was found that there was a decrease in complaints of Musculoskeletal Disorder in the student body. With the contribution of the study table, it can be adjusted up and down (adjustable) to make the use of the chair more comfortable.

Keywords: Questionnaire, Observation, Musculoskeletal Disorder, REBA, RULA.

1. Introduction

Tables and chairs are very important physical facilities because student learning activities are mostly spent in the classroom such as reading, drawing, writing and other activities. Therefore, schools must provide classroom furniture that can meet the needs of students[1], With the phenomena that occur in the Brantas Vocational High School computer laboratory class as follows:

- a. From observations[1] in the learning process the neck position rotates sideways when students see the teacher explaining the material on the blackboard with a rather long time duration of about 20-30 minutes, which results in pain in the upper neck, back pain and which is then continued with a note-taking position material given by the teacher with the body rotating back to face the table,

the body leaning forward, the wrist bent, the writing position of the hand hanging out of the table board area which resulted in the rapid fatigue of the right hand and it was also done repeatedly with a long duration due to the shape of the chair is not ergonomic.

- b. From the results of distributing questionnaires[1] to 35 students, it was found that complaints from students were obtained from the data on the results of student complaints through questionnaires: complaints on the neck were 100%, on the back 85%, the right upper arm 71%, the right forearm 71 % and the right hand 71%.

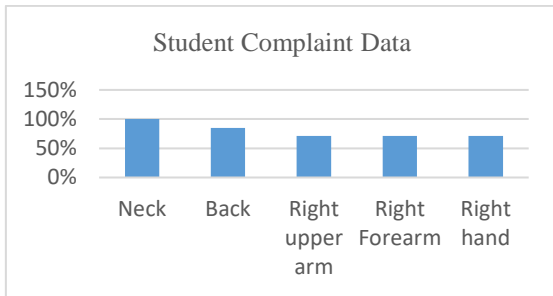


Figure 1 Student Complaints Diagram

Nordic Body Map (NBM) is an initial identification in determining the symptoms of Musculoskeletal Disorder by taking an ergonomic approach more objectively in determining the risk of Musculoskeletal Disorder. Rapid Entire Body Assessment (REBA) is a method developed in the field of ergonomics and can be used quickly to assess the work position or posture of an operator's neck, back, wrists and feet. In addition, this method is also influenced by the coupling factor, external loads that are supported by the body and the activities of the workers[2]

Rapid Upper Limb Assissment (RULA) is a method developed in the field of ergonomics that investigates and assesses the work positions performed by the upper body[3].

2. Basic Theory

2.1 Musculoskeletal Disorder

Musculoskeletal complaints are complaints in the skeletal muscles, ranging from very mild complaints to very painful. Muscles that receive static loads repeatedly and continuously for a long time, can cause complaints of damage to joints, ligaments and tendons. Complaints to damage, this is usually termed complaints of musculoskeletal disorders or injuries to the musculoskeletal system[4].

2.2 REBA

REBA is a method developed in the field of ergonomics and can be used to quickly assess the work position or posture of an operator's neck, back, arms, wrists and feet. Apart from that, this method is also influenced by the coupling factor, external loads that are supported by the body and the activities of the workers. Assessment using REBA does not take a long time to complete and do a general

scoring on a list of activities which indicates the need for risk reduction caused by the operator's work posture[2].

REBA checks can be carried out in a confined space without disturbing workers. REBA development occurs in four stages. The first stage is taking the worker's posture data using the help of videos or photos, the second stage is determining the angles of the worker's body parts, the third stage is determining the weight of the object being lifted, determining the coupling, and determining the worker's activity. And finally, the fourth stage is the calculation of the REBA value for the posture in question. By obtaining the REBA value, it can be seen the level of risk and the need for action that needs to be taken to improve work[2].

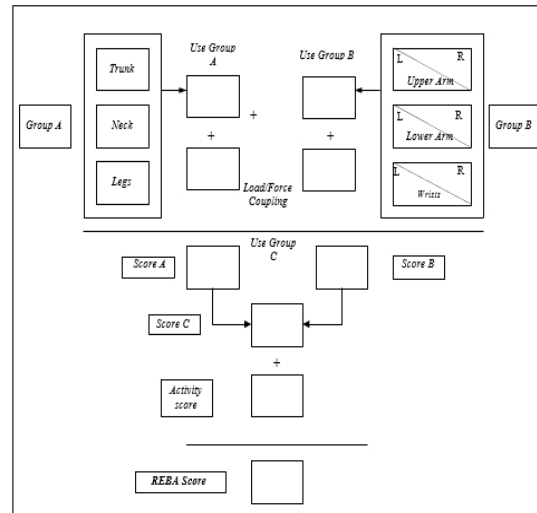


Figure 2 Calculation Steps of the REBA Method

2.3 RULA

RULA is a method developed in the field of ergonomics that investigates and assesses the work positions performed by the upper body. This method does not require special tools to provide assessments in neck, back and upper body posture and this method uses diagrams of body posture and three score tables in determining risk factor evaluations [3].

There are four main applications of the Rapid Upper Limb Assessment (RULA)[3]., namely:

1. Measuring Musculoskeletal risk, usually as part a broader improvement of ergonomics.
2. Comparing the Musculoskeletal Load between the old work station design and the latest obtained design results.

- Evaluating output such as productivity or appropriateness of the use of design results.
- Train workers about the musculoskeletal load caused by differences in work postures.

To facilitate the assessment of body posture, the assessment of body posture is divided into 2 group segments, namely Group A and Group B values [3].

The development of this Rula consists of three stages[3]:

- Identify work posture
- Scoring system
- The scale of the level of action provides a guide on the level of risk that exists and is needed to encourage a more detailed assessment of the analysis that is obtained.

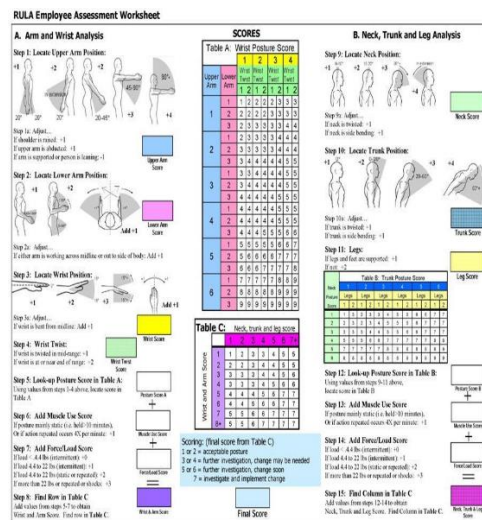


Figure 3 Analysis sheet of RULA

3. Research Methods

In this study it can be said as descriptive research[5].Where this study aims to describe the problems and solutions of non-ergonomic infrastructure that cause musculoskeletal disorders in students of the computer laboratory of SMK Brantas Karangates. The research steps are.

3.1 Data Collection

Posture Data Related to Musculoskeletal Disorder:

Data obtained from the distribution of questionnaires and observations to 35 students as samples in the study.

3.2Data processing using the REBA method and RULA method

The methods used to process posture data related to Musculoskeletal Disorder which are useful for investigating and assessing the learning positions performed by the upper body include:neck, back, upper right arm, right lower arm and right hand are:

The development of the REBA method occurs in four stages[6], namely:

- The first stage is to collect worker posture data using videos or photos.
- The second stage is to determine the angles of the worker's body part.
- The third stage is determining the weight of the object being lifted, determining the coupling, and determining the activities of the workers.
- The fourth stage is the calculation of the REBA value for the posture in question. By obtaining the REBA value, it can be seen the level of risk and the need for action that needs to be taken to improve work.

The development of the RULA method consists of three stages[6], namely:

- Identify work posture
- Scoring system
- The scale of the level of action provides a guide on the level of risk that exists and is needed to encourage a more detailed assessment of the analysis that is obtained.

3.3 Form of the Proposed Ergonomic Study Desk Chair Design.

The contents of this chapter are the shape and dimensions of the Ergonomic Study Desk Chair coupled with the contribution of the study table which can be adjusted up and down (Adjustable).

3.4 Test Results of the Ergonomic Study Desk Chair design.

From the initial number of testing the actual study table chair form 35 students and these students will also test the new Study Table Chair Design which will later on the results of this test are expected to be able to minimize complaints of musculoskeletal disorders in the student body.

4. Research and Discussion Results

4.1. Research Result

Posture data related to mucocoskeletal disorder are here to get data from photo

shoots for students during learning, as shown below:



Figure 4 Students Look at



Figure 5 Students Write

4.2 Analyzing Data

REBA Method Data Processing.

Assessment of Group A's posture when students turn (Figure 2).

The description of the analysis of Figure 2 above, namely:

- Position of the body forming an angle of 50 °, then given: score 3 (Enter table 1 Group A).
- The position of the neck looking to the side is given: score 3 (Enter table 1 Score Group A).
- The position of the two legs resting on the leg of the table and forming an angle of 120 °, is given: score 3 (Enter table 1 Group A).

Table 1 Score Group A

Tabel A	Neck												
	1				2				3				
Legs	1	2	3	4	1	2	3	4	1	2	3	4	
Trunk	1	1	2	3	4	1	2	3	4	3	3	5	6
Posture	2	2	3	4	5	3	4	5	6	4	5	6	7
Score	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9

The final posture score for Group A: Group A table + load value (load value less than 5 kg) then the final score: $7 + 0 = 7$ (enter the table 3 score Group C)

Posture assessment when writing group B scores (Figure 3)

The description of the assessment analysis of Figure 3 above, namely:

- The posture of the forearm at a 40 ° angle is given: score 2 (entered in Table 2 Group B).
- Posture of the forearm at an angle of 16 °, given: score: 2 (entered Table 2 Group B).
- The wrist posture formed an angle of 15 °, given a score of: 2 (entered Table 2 Group B).

Table 2 Score Group B

Table B	Lower Arm					
	Wrist		1		2	
Upper	1	1	2	2	1	2
Arm	2	1	2	3	2	3
Score	3	3	4	5	4	5

- Customers are given a score: 0

Then the final score of posture B is: $3 + 0 = 3$ (in Table 3 Score Group C)

Group Score Assessment C

Table 3 Score Group C

Score A (Score From Table A + Load Force)	Tabel C Score B (Table B + Coupling Score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	2	2	2	3	4	4	5	6	6	7	7	8
3	3	3	3	3	4	5	6	7	7	8	8	8
4	4	4	4	4	5	6	7	8	8	9	9	9
5	5	5	5	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	7	8	9	9	9	10	10	11	11

To determine the final score from the REBA method, there must be an increase between the "score Table C" with an increase in the type of muscle activation so that the value of the posture is obtained. Group C value + Repetitive movement that occurs more than 4 times.

Then the final score from the REBA Method is: $7 + 1 = 8$

From the final score obtained in Group C's score of 8, this value is included in Action Level 3, the student's posture is in the High category so that action is needed immediately.

Data Processing RULA Method.

Posture assessment when writing group A scores (Figure 3).

The description of the analysis of Figure 3 above, namely:

- a. Upper arm forming a 40 ° angle is given: Score 3 (enters table 4 Group A)
- b. The forearm angles 108 ° and working away from the center line is given: Score 3 (enters table 4 Group A)
- c. Wrist at 16 ° angle, working away from center: Score 3 (enters table 4 Group A)
- d. Wrist rotation near the turn is given: Score 2 (enters table 4 Group A)
- e. Repetition activities carried out more than once then given: score 1
- f. Load <2 kg given: score

Table 4 Score Group A

		Wrist							
		1		2		3		4	
Upper Arm	Lower Arm	Wrist Twist	Wrist Twist	Wrist Twist	Wrist Twist	Wrist Twist	Wrist Twist	Wrist Twist	Wrist Twist
		1	2	1	2	1	2	1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	2	3	3	3	3	3
2	1	2	2	2	3	3	3	4	4
	2	2	2	2	3	3	3	4	4
	3	2	3	3	3	3	4	4	5
3	1	2	3	3	3	4	4	5	5
	2	2	3	3	3	4	4	5	5
	3	2	3	3	4	4	4	5	5

The final total score for Group A is:
 Group A posture score + activity score + Load score
 $4 + 1 + 0 = 5$ (enter the 6 Final Score table)

Group B posture assessment when looking (Figure 2)

The description of the analysis of Figure 4.6 above, namely:

- a. Posture of the neck looking to the side, given a score: $4 + 1 = 5$ (entered table 5 Group B)
- b. Back posture forms an angle of 50 °, given a score: 3 (entered table 5 Group B)
- c. The position of the legs on a sitting position means that they are in a balanced state: score 1 (entered table 5 Group B)
- d. Repetition activities carried out more than once then given: score 1
- e. Load <2 kg given: score

Table 5 Score Group B

		Trunk																	
		1			2			3			4			5			6		
Neck	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs	Legs		
Legs		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2		
1	1	3	2	3	3	4	5	5	6	6	7	7	7	7	7	7	7		
2	2	3	2	3	4	5	5	5	7	7	7	7	7	7	7	7	7		
3	3	3	3	4	4	5	5	5	7	7	7	7	7	7	7	7	7		
4	5	5	5	6	6	7	7	7	7	7	7	7	8	8	8	8	8		
5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7		
6	8	8	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9		

The final total score for Group B is:
 Group B posture score + activity score + Load score
 $7 + 1 + 0 = 8$ (enter table 6 Score Group C)
Group Posture Assessment C

Table 6 Score Group C

		Nilai A													
		1		2		3		4		5		6		7+	
Nilai B	Nilai A	1	2	1	2	1	2	1	2	1	2	1	2	1	2
B	1	1	2	3	3	4	4	5	5	6	6	7	7	7	7
	2	2	2	3	4	4	4	5	5	6	6	7	7	7	7
	3	3	3	3	4	4	4	5	6	6	7	7	7	7	7
	4	3	3	3	4	4	5	6	6	7	7	7	7	7	7
	5	4	4	4	5	6	6	7	7	7	7	7	7	7	7
	6	4	4	5	6	6	7	7	7	7	7	7	7	7	7
	7	5	5	6	6	7	7	7	7	7	7	7	7	7	7
	8	5	5	6	7	7	7	7	7	7	7	7	7	7	7

From the final score obtained in Group C's score of 7, this value is included in Action Level 4. After the Action Level is determined, the new researchers can find out that the student's body posture level is in the high category and is dangerous for the safety, health and comfort of students so that action right now.

By looking at the results of the REBA method and the RULA method which are so very worrying, the researcher proposes the need for action to prevent complaints in the student body with the Ergonomic Learning Chair Design so that it is expected to be able to minimize fatigue on the student's body when the learning process takes place in the Computer Laboratory.

Form of the Proposed Ergonomic Study Desk Chair Design.

Dimensions of Study Chair Design

After the percentile calculation is obtained, the next step is to determine the following dimensions

Table 7 Dimensions of New Design Chairs

No	Design Results	Dimension (cm)
1	Dimensions (cm)	43
2	Chair Pedestal Length	45
3	Seat Width	43
4	Seat Back Height	56
5	Seat Beck Width	48
6	Table Length	61 & 30
7	Table Width	28
8	Table height from surface	68
9	Thicnees of Table	2
10	Table Haight on Chair Pad/ down Position	0
11	Table Haight on Chair Base / Raised Position	16

After the dimensions of the Ergonomic Study Desk Chair are determined, then we do the making of the study table chair with tool materials that have become the procedure for making Ergonomic study table chairs. With the results in the image below by contributing to this study, the table can be adjusted up and down (Adjustable) adjusted by the user of the desk chair for study alone.

No	Complaints Sic	Chair Old Study Table	New Study Chair Design
1	Neck	35 student (100%)	3 student (0,085%)
2	Backs	30 student (85%)	4 student (0,11%)
3	Right Upper Arm	25 student (71%)	4 student (0,11%)
4	Lower Right Arm	25 student (71%)	5 student (0,17%)
5	Right Hand	25 student (71%)	7 student (0,2%)

Figure 6 Ergonomics Study Desk Chair



Figure 7 Contribution Study Table Chair Ergonomis



Test Results of the Ergonomic Study Desk Chair design

By conducting tests on the use of study desk chairs to 35 predetermined samples, namely the predecessor samples which were used as initial testing of actual table chairs and the results obtained from testing of ergonomic study desk chairs were tested on students who had been recapitulated with the results of comparisons of complaints against actual desk chair use with the new ergonomic study desk chair. **Table 8 Recapitulation of the Comparison questionnaire Test of the Actual Study Table Chair with the Latest Study Table Chair**

5. Conclusion

Based on the results of dataprocessing and analysis that has been done, the following conclusions can be drawn:With the REBA Method and RULA Method approach to detect work posture and investigate upper limb disorders. With the REBA method the final score obtained in Group C is 8, then this value is entered at Action Level 3, after which researchers can only find out that the student's body posture level is in the High category so

that action is needed immediately. With the RULA method, the results obtained by the student's body activity were the Goup C score of 7, then the score entered Action Level 4 so that the student's body posture level was in the dangerous category. To solve this problem, a proposal with an Ergonomic Study Chair Design is needed [7].

With the Ergonomic Study Table Chair test for learning in the Computer Laboratory, it has been found that the use of the latest study desk chairs can reduce complaints of Musculoskeletal disorder in the students of SMK [8].

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Judul Tesis : DESAIN KURSI BELAJAR ERGONOMIS
Dosen Pembimbing : Dr. Ir. H. Julianus Hutabarak, MSIE

No	Hari, Tanggal	ASSISTENSI	Tanda Tangan/ Paraf
1	11/01/2020	1. Flow Chart penelitian perbaiki 2. Exp. Definisi terkait sudut meja pada kursi 3. Konfigurasi pengaturan Kemiringan Meja	
2	20/01/2020	1. Perbaiki: • Rumusan Masalah • Tujuan dan Manfaat Penelitian	
3	25/01/2020	OK / ACC Sempro	
4	11/3/2020	Masukan tingkatan hasil NBP ke Bab V.	
5	15/5/2020	Perhitungan sudut kemiringan Meja di cek kembali.	
6	10/6/2020	Simpulkan hasil Penelitian dan tentukan sudut kemiringan meja yang diminati dan paling ergonomis..	



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7	30/6/2020	Kaitkan hasil Nordic terpilih dengan kondisi awal maka bisa terlihat dengan jelas peningkatan kenyamanannya	2
8	6/7/2020	OK/ ACC Semhas.	2
9	5/11/2020	Perbaiki hasil Uji Desain perancangan kursi Ergonomis.	2
10	16/11/2020	Buat tabel perbandingan antara hasil desain kursi meja belajar lama dengan kursi meja belajar terbaru hasil desain.	2
11	23/11/2020	Perbaiki Rangkuman.	2
12	27/11/2010	OK/ACC Ujian Tesis	2

Malang, 12 Februari 2021

Dosen Pembimbing I

Dr. Ir. H. Julianus Hutabarak, MSIE



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LEMBAR ASISTENSI

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NIM : 18.111.001
Judul Tesis : DESAIN KURSI BELAJAR ERGONOMIS
Dosen Pembimbing : Dr. Dimas Indra Laksamana, ST. MT.

No	Hari Tanggal	ASISTENSI	Tanda Tangan/ Paraf
1	13/1/2020	1. Perbaiki Penelitian pada Latar Belakang. 2. Sumber Teori Bab 2 usahakan 5 tahun terakhir.	
2	18/1/2020	1. Perbaiki Penulisan pada Bab 1 2. Cek Sumber-sumber Bab 2 3. Cek Sumber-sumber penemu teori (10 tahun Terakhir).	
3	23/1/2020	1. Cek Perbedaan penelitian. 2. Perbaiki penulisan Daftar Pustaka	
4	4/2/2020	OK/ ACC Sempro	
5	15/8/2020	1. Pengecekan Radaksional Tesis 2. Perbaiki Alir Penelitian.	
6	7/9/2020	1. Perbaiki Format Penelitian 2. Perbaiki Layout penulisan	



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Kampus II : J. Raya Karangas, Km 2 Telp. (0341) 417635 Fax. (0341) 417634 Malang

7	19/9/2020	1. Pada Tujuan buat dua nomer untuk menjawab Rumusan Masalah pada latar belakang penelitian. 2. Perbaiki penulisan Bab 3.	
8	24/9/2020/	1. Cek Tampilate 2. Perbaiki Referensinya	
9	5/10/2020	OK/ACC Semhas	
10	4/1/2021	Periksa kembali jangan sampai ketukar, uji Statistik kemudian analisis.	
11	15/1/2021	Perbaiki runtutan seperti bab III (Metode Penelitian), lengkapi hasil, jelaskan secara lengkap, detail dan urut, tambahkan penjelasan (intrepetasi) pembanding(lama/baru).	
12	10/2/2021	OK/ACC Ujian Tesis	

Malang, 12 Februari 2021

Dosen Pembimbing II

Dr. Dimas Indra Laksamana, ST, MT