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A survey Method and new design Lecture Chair for Complied Ergonomics Guideline at Class room Building 2 Suranaree University of Technology, Thailand

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***Abstract*—**The paper describes ergonomics problems trend of student at B5101 classroom building 2, Suranaree University of Technology. The objective to survey ergonomics problems and effect from use chairs for sitting in class room. The result from survey method 100 student they use lecture chair for sitting in classroom more than 2 hours/ day by RULA[1]. and Body discomfort survey[2]. The result from Body discomfort survey contribute fatigue problems at neck, lower back, upper back and right shoulder 2.93, 2.91, 2.33, 1.75 respectively and result from RULA contribute fatigue problems at neck, body and right upper arm 4.00, 3.75 and 3.00 respectively are consistent. After that the researcher provide improvement plan for design new chair support student fatigue reduction by prepare data of sample anthropometry and design ergonomics chair prototype 3 unit. Then sample 100 student trial to use new chair and evaluate again by RULA, Body discomfort and satisfaction. The result from trial new chair after improvement by RULA present fatigue reduction average of head and neck from 4.00 to 2.25 , body and trunk from 3.75 to 2.00 and arm force from 1.00 to 0.25 respectively. The result from trial new chair after improvement by Body discomfort present fatigue reduction average of lower back from 2.91 to 0.87, neck from 2.93 to 1.24, upper back 2.33 to 0.84 and right upper arm from 1.75 to 0.74. That statistical of RULA and Body discomfort survey present fatigue reduction after improvement significance with a confidence level of 95% (p-value 0.05). When analyzing the relationship of fatigue as part of the body by Chi – square test during RULA and Body discomfort that before and after improvements were consistent with the significant level of confidence 95% (p-value 0.05) . Moreover the students satisfaction result from trial with a new chair for 30 minutes [3]. 72 percent very satisfied of the folding of the secondary writing simple 66% the width of the writing plate, 64% the suitability of the writing plate, 62% of soft seat cushion and 61% easy to seat the chair.

***Keywords*—**Ergonomics, Work station design, Ergonomics Chair, Student, Fatigue

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I. Introduction

THE learning environment are key factors for support learning effective such as physical environment, moreover ergonomics is 1 factors are important such as size, width, height of desk chairs, distance during desk and student, distance during LCD projector and student and sound system in classroom. All of this should be consistent with ergonomics guideline to achieve maximum efficiency and effectiveness in learning. That learning efficiency is necessary to consider elements. Chairs used for sitting course is another one of the most important element to learn in a classroom of students. If the chair is used for students inappropriate body or the ergonomics, it will affect the health, fatigue, discomfort and affect for learning efficiency.Therefore, the research team has made this project. To study the problem, and the impact caused by the use of chairs for sitting in a classroom of students learning. Questionnaires were used only to fatigue. Arising from the use of classroom chairs for sitting. And to provide the improved chair designed for students sitting the proper ergonomics. Sitting posture and proper. To reduce fatigue. Discomfort caused by the chair used for seated student. To achieve maximum efficiency and effectiveness in learning.

II. Material and Method

1. Set up ergonomics problems survey plan at classroom B5101 learning building 2 and selected population and sample
2. Prepare a questionnaire for support ergonomic problems survey and distributed questionnaires to the sample.
3. Collect data and analyzed for identification and prioritize the problems and prepared improvement plan by follow ergonomics guideline.
4. The necessary anthropometric dimensions of the population are obtained or approximated from the result of the available anthropometric surveys reasonably represent the user group. As this dimensions are taken from nude subject in an erect posture, they need to be corrected appropriately for the effect of clothing, shoe and normal slump posture

5. Developing new lecture chair design for complied data of mainly population anthropometry
6. The students trial new lecture chair to compared the

difference between before and after improvement. 7. Prepare a questionnaire for support ergonomic problems survey and distributed questionnaires to the sample again for compared student fatigue after improvement. 8. Summary data and analysis by pared-t test and Chi-square test.

III. Result and Discussion

The study focus students they study in classroom B5101 building 2 Suranaree University of Technology, 100 people are male 23%, female 76 %. Majority of population age is 19 years old are 64%. The majority of hight ranged from 151 to 160 cm. are 50% . The majority of the weight ranged from 41 to 50 kg. are 44 %. The majority of the samples from the Institute of Medicine 63%, and most are studying in 1st year 82% and were not history of accidents related muscles and skeletal 74% , moreover 96% contribute fatigue when they used chair in the classroom B5101 and chair picture present in Fig. 1

Fig. 1 Lecture chair before improvement

The ergonomics assessment result by RULA contribute fatigue problems at neck, body and right upper arm 4.00, 3.75 and 3.00 respectively are consistent and total score estimate 5-6 score range indicates that the assessment work has been started should be studied further problems. And expeditiously improve the work . The ergonomics assessment result by RULA are presented in table I

The result from Body discomfort survey contribute fatigue problems at neck, lower back, upper back and right shoulder 2.93, 2.91, 2.33, 1.75 respectively. That present in table II

After that the researcher provide improvement plan. A Lecture chair station design objective is to ensure that the majority of the population of the intended user group can be accommodated comfortably, without any harmful posture. For the physical design of lecture chair station. The seven essential design dimensions are : (1) popliteal height, (2) buttock-popliteal length, (3) elbow height-sitting, (4) shoulder height-sitting, (5) buttock breadth, (6) lumbar support height. An engineering/structural anthropometry approach is used in determining the lecture chair station dimensions. The result of anthropometry dimensions present in table III . The relevant ergonomics principles and the determinations of the above dimensions are discussed in the following section.

TABLE I
THE ERGONOMICS ASSESSMENT RESULT BY RULA SEPARATE BY PART OF BODY

Part of body	Mean	SD	Max-score
Upper arm-left	3.00	0.82	6
Upper arm-right	3.00	0.82	6
Lower arm-left	2.70	0.50	4
Lower arm-right	2.70	0.50	4
Wrist posture-left	2.25	0.50	4
Wrist posture-right	2.25	0.50	4
Wrist twist-left	1.00	0	2
Wrist twist-right	1.00	0	2
Frequency or Force (arm)-left	1.00	0.82	2
Frequency or Force (arm)-right	1.00	0.82	2
Neck	4.00	0.82	6
Trunk	3.75	0.96	6
Leg and foot	1.00	0	2
Frequency or Force (neck, trunk and Leg)	0.50	0.58	1

TABLE II
THE ERGONOMICS ASSESSMENT RESULT BY BODY DISCOMFORT SEPARATE BY PART OF BODY

Part of body	Mean	SD
Neck	2.93	2.05
Lower back	2.91	1.99
Upper back	2.33	1.99
Shoulder-left	1.52	1.74
Shoulder-right	1.75	1.95
Elbow-left	0.83	1.57
Elbow-right	1.01	1.62
Wrist-left	0.58	1.21
Wrist-right	0.76	1.36
Thigh-left	1.41	1.76
Thigh-right	1.36	1.78
Knee-left	1.12	1.65
Knee-right	1.11	1.60
Foot-left	0.70	1.39
Foot-right	0.73	1.45

TABLE III
THE RESULT OF ANTHROPOMETRYDIMENSIONS 100 STUDENT AT CLASSROOM B5101 SURANAREE UNIVERSITY OF TECHNOLOGY

Body Anthropometry	Percentiles		
	5	50	95
1. popliteal height	43.18	50.32	55.83
2. buttock-popliteal length	43.18	50.67	60.17
3. elbow height-sitting	19.05	22.63	27.94
4. shoulder height	48.26	54.13	62.23
5. buttock breadth	27.94	33.07	38.13
6. forearm length	19.13	24.10	31.19

After measurement anthropometry dimensions the researcher used data from anthropometry combined with data from ergonomics chair guideline [4] . In table IV refer data of research use for chaire design.Then they design ergonomics lecture chair prototype 3 unit for trial. The ergonomics lecture chair prototype present in Fig.2

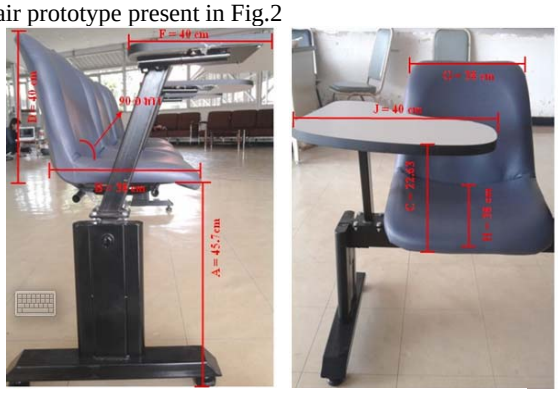

Fig. 2 The ergonomics lecture chair after improvement

TABLE IV
THE ANTHROPOMETRY DIMENSIONS BETWEEN BEFORE AND AFTER IMPROVEMENT

Anthro-pometry	Percentiles	Before (cm.)	After (cm.)
1. popliteal height	Percentile 5 = 43.18 cm. (Adjust heels 2.53 cm.)	43	45.7
2. buttock-popliteal length	Percentile 5 = 43.18 and adjust clearance -5 cm.	40	38.18
3.elbow height-sitting	Percentile 50 = 22.63	18	22.63
4.shoulder height		75	118.06
5. buttock breadth	Percentiles 95 = 40.61	39	41
6. Height of lumbar support[4]	Percentile 50	0	16
7. Width of writing plate	-	25	40
8. Lumbar width support[4]	Percentiles 95	0	30
9. Slope of backrest[4]	-	100 degree	90-110 degree

Then student 100 people in the same group before improvement. They trial to used ergonomics lecture chair 30 minute/people .and evaluate again by RULA, Body discomfort survey and take satisfaction questionnaire. The ergonomics lecture chair before and after improvement present in Fig.3 and the picture from student trial before and after improvement present in Fig.4.

Fig.3 The ergonomics lecture chair before and after improvement

Fig.4 the picture from student trial ergonomics lecture chair before and after improvement present

The result from trial new chair after improvement where body parts have value when fatigue lower average is back below from 2.91 to 0.87 followed by the neck from 2.93 to 1.24 back on from 2.33 to 0.84 the results using evaluation RULA ago - after improvement was found that the fatigue average parts. Body samples after the experiment chair made ergonomics is reduced with statistical significance with a confidence level of 95% (p-value = 0.002), where body parts have value when fatigue average declined from head and neck 4.00 to 2.25 where the body 3.75 to 2.00 of the strength of muscles, arms, 1.00 to 0.25, respectively.

TABLE V
THE ERGONOMICS ASSESSMENT RESULT BY RULA SEPARATE BY PART OF BODY COMPARED BETWEEN BEFORE AND AFTER IMPROVEMENT

Part of body	Before		After	
	Mean	SD	Mean	SD
Upper arm	3.00	0.82	2.75	0.50
Lower arm	2.70	0.50	2.00	0.82
Wrist posture	2.25	0.50	2.00	0
Wrist twist	1.00	0	1.00	0
Frequency or Force (arm)	1.00	0.82	0.25	0.50
Neck	4.00	0.82	2.25	0.50
Trunk	3.75	0.96	2.00	0
Leg and foot	1.00	0	1.00	0
Frequency or Force (neck, trunk and Leg)	0.50	0.58	1.00	0

TABLE VI
THE ERGONOMICS ASSESSMENT RESULT BY BODY DISCOMFORT SEPARATE BY PART OF BODY BETWEEN BEFORE AND AFTER IMPROVEMENT

Part of body	Before		After	
	Mean	SD	Mean	SD
Neck	2.93	2.05	1.24	1.46
Lower back	2.91	1.99	0.87	1.19
Upper back	2.33	1.99	0.84	1.16
Shoulder-left	1.52	1.74	0.60	1.17
Shoulder-right	1.75	1.95	0.74	1.23
Elbow-left	0.83	1.57	0.53	1.03
Elbow-right	1.01	1.62	0.42	0.84
Wrist-left	0.58	1.21	0.39	0.89
Wrist-right	0.76	1.36	0.53	0.93
Thigh-left	1.41	1.76	0.66	1.03
Thigh-right	1.36	1.78	0.63	0.93
Knee-left	1.12	1.65	0.83	1.22
Knee-right	1.11	1.60	0.64	0.99
Foot-left	0.70	1.39	0.46	1.03
Foot-right	0.73	1.45	0.18	0.52

When analyzing the relationship of fatigue as part of the body by Chi – square test during RULA and Body discomfort that before improvements were consistent with the significant level of confidence 95% (p-value 0.05) and after improvement were consistent with the significant level of confidence 95. % (p-value 0.05).

TABLE VII
THE STUDENT SATISFACTION AFTER TRIAL TO USED NEW LECTURE CHAIR

Subject	Mean	SD	Max satisfaction (%)
1. Install lumbar support at backrest	4.33	0.53	36
2. The strong of backrest	4.47	0.63	53
3. Height of backrest	3.84	0.86	29
4. Width of backrest	4.31	0.58	37
5. Width of seat cushion	4.22	0.71	35
6. Comfortable of seat cushion	4.55	0.64	62
7. The slope of seat cushion	3.95	0.83	30
8. Comfortable of entrance chair	4.55	0.61	61
9. The strong of chair	4.48	0.59	53
10. Height of chair	4.34	0.77	52
11. Comfortable of seat chair	4.53	0.61	58
12. An appropriate of writing plate	4.58	0.60	64
13. Width of writing plate	4.57	0.65	66
14. suitable of writing plate folding are simple	4.68	0.55	72
15. overall satisfaction from use ergonomics lecture chair	4.51	0.58	55

The students satisfaction result from trial with an ergonomics lecture chair for 30 minutes 72 percent very satisfied suitable of writing plate folding are simple. 66% the width of the writing plate, 64% the suitability of the writing plate, 62% of comfortable of seat cushion and 61% easy to entrance the chair.

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