



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

# **The Ergonomic Factor of a Flexible Writing Table Chair for Left Handed Student**

Thesis submitted in accordance with the partial requirements of the  
Universiti Teknikal Malaysia Melaka for the  
Bachelor of Manufacturing Engineering (Manufacturing Management)

By

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Faculty of Manufacturing Engineering

October 2007



# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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## APPROVAL

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## **ABSTRACT**

The ergonomic factors for each of the product produced are the main factor for the consumer. It will give the positive perception for the consumer if the product achieves an ergonomic factor. This study is conducted to study the ergonomic factors of the writing table chair for left handed students.

A survey from the questionnaire is conducted to know the public opinion and complaint of the current chair. The questionnaire consists of thirteen questions which will ask about the satisfaction and the effect of the current chair. There are 60 participants that were taken which consist of 15 left handed students and 15 right handed students. From 15 students, it was divided into two groups which are female student and male student.

The data was then analyzed to determine the differences between the left handed and right handed students. Besides that, the differences between genders also must be determined.

From the result, the data was then taken to be analyzed by using the RULA and CATIA software. The software was used to determine the optimum seat position and to prevent awkward position. The software also can determine the ergonomics of the chair. Then, the product will be designed according to the guidelines, ISO Standards, and achieve the ergonomic factor from the analyzing through the software.

## **ABSTRAK**

Faktor ergonomik merupakan salah satu faktor yang mempengaruhi sesebuah produk itu dari sisi pandangan pengguna. Jika ia dihasilkan dengan mempunyai tahap ergonomik yang tinggi, produk tersebut akan memberi persepsi yang positif pengguna terhadap produk tersebut. Kajian ini dijalankan untuk mengkaji faktor ergonomik sebuah kerusi-meja tulis untuk pelajar yang menulis menggunakan tangan kiri.

Satu tinjauan telah dijalankan dengan menggunakan satu set boring soal selidik untuk mengetahui tahap ketidakpuasan pengguna terhadap produk yang sedia ada. Boring kaji selidik tersebut mengandungi sebanyak 13 soalan yang menanyakan tentang kepuasan dan kesan kerusi sedia ada terhadap pengguna. Sebanyak 60 orang telah diberikan borang ini di mana 15 daripadanya menggunakan tangan kanan dan 15 lagi menggunakan tangan kiri. Daripada 15 orang tersebut di bahagikan lagi kepada dua di mana separuh daripada mereka lelaki dan separuh lagi perempuan.

Data tersebut kemudiannya dianalisa untuk menentukan perbezaan yang timbul antara mereka yang menggunakan tangan kanan atau kiri ketika menulis menggunakan kerusi yang sedia ada. Selain itu, perbezaan antara jantina juga perlu diambil kira.

Daripada keputusan yang diperolehi, data akan dianalisa dengan menggunakan RULA dan CATIA. Perisian atau program ini akan menentukan tahap optimum posisi duduk dan mengelakkan duduk secara janggal. Selepas itu, produk yang baru akan direkabentuk dan diuji menggunakan program atau perisian RULA dan CATIA.

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## **LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE**

MCDs	-	Musculoskeletal Disorders
ISO	-	International Organization for Standardization
JIS	-	Japan Industrial Standard
BS	-	British Standard
DIN	-	Deutsches Institut für Normung e.V. (German Institute for Standardization)
KS	-	Korean Industrial Standard
NIOSH	-	National Institute for Occupational Safety and Health
RICE	-	Rest, Ice, and Compression
MRI	-	Magnetic Resonance Imaging
UiTM	-	Universiti Teknologi Mara
MMU	-	Multimedia University
RULA	-	Rapid Upper Limb Assessment
CATIA	-	Computer Aided Three Dimensional Interactive Application
PVC	-	Polyvinyl Chloride
No.	-	Number
cm	-	Centimeters
BMI	-	Body Mass Index

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Project**

The purpose of this project is to study the ergonomic factor of a writing table chair for left handed student. The study also needs to design the new writing table chair which achieves the satisfaction and ergonomics factors for the consumers. The study will determine the problem that occurred during the usage of the chair for certain duration such as the lecture hour or lab session. The study and data collection of this project will be held at the Universiti Teknikal Malaysia Melaka (UTeM).

The study was done because of the effect to the students. The effects to the abdomens such as neck, forearm, back, shoulder, head can hampers the students learning abilities and they cannot concentrate during the lecture session. This study was also done because of the own experience during the lecture session. Besides that, the study also was done because of the complaint which came from most of the students.

### **1.3 Problem Statement**

Affective user satisfaction is one of the most important factors for a product to be successful in the market. Companies spend a significant amount of efforts designing an



effective product. For consumer products, affective user satisfaction is considered as important as product functionality. Basically, most of the product performance and appearance is closely related to the affective user satisfaction. A comfortable product was a product that must be purchased to the consumers.

Nowadays, the products that wanted to produce to the customer need to achieve the standard that can afford and support the human body and body parts. Therefore, the comfort on the musculoskeletal system and low back must be achieved to prevent the injuries to the consumers especially students.

The using of the writing chairs nowadays for the extended periods of time especially during the work or lecture can influence the performance of the workers and also hampers the students learning abilities because they cannot concentrate due to the uncomfortable products according to Moon et al. (1995) and Drury and Coury (1982). The uncomfortable factors of the chairs are because of such as bad posture, poor seating and long duration of time of seating.

Moreover, this could lead to the intervertebral disk degeneration such as scoliosis, hyperlordosis, and hyperkyphosis. Moon et al. (1995) and Moon et al. (1996) conducted the scoliosis screening test and reported that 2.16% in 1983, and 6.0% in 1995 of female high school students in Korea were diagnosed with scoliosis of over  $10^0$  of Cobb's angle. It was because, based on this research finding, is improperly designed study table and chairs, poor posture, wearing heavy backpacks, and a lack of exercise.

The uncomfortable chairs also can cause the pain to the certain abdomens of the human. The abdomens such as neck, forearm, back, shoulder, head and many more can be pain when the humans seating at the uncomfortable chairs for a long duration of time. The lower back, neck, and shoulder were the most common sites of pain.

The bad posture can be seen when the left handed student starting to write the note. The load is more at the right side of the chair. So, the sustainability of the flexible chair can be questioned. The chair also seem not stable when the student of left handed started to write. Aagaard-Hansen and Storr-Paulsen (1994) found that, the students seated between 19 to 90 minutes for a double session. On the time spent seated, 57 % was spent leaning forward (e.g. writing or painting) with 43% spent doing backward leaning activities (e.g. looking at whiteboard or painting).

### **1.3 Objectives**

The objectives of this study are:-

- 1.3.1 To identify the problems that occurred during the usage of the current table chair.
- 1.3.2 To analyze the ergonomic of the current chair for left handed student by using the RULA in CATIA software.
- 1.3.3 To design the new table chair that can overcome the problems that were facing by left handed student previously by using the CATIA.
- 1.3.4 To analyze the new design of the table chair for left handed student by using the RULA in CATIA software.

### **1.4 Scopes**

This study is focused on the students especially University Teknikal Malaysia Melaka. The students that need to be studied is left handed students but the data collected was also including the right handed students for the comparison between both of this group. The reason for this method is the design of the new writing table chair can conclude this factor for the satisfaction of the students. Beside that, this study also needs to consider

the gender of the students. It is because usually the female student height and shape was smaller than the male student. The study also needs to consider about the races of the participants. It is to match the size of each major race in Malaysia such as Malay, Chinese and India when the designing of new writing table chair was done. So, these factors also need to be determined before the design of the new writing table chair started.

### **1.5 Importance of the Project**

This study is importance for the future because the study can implement the new writing table chair which can achieve the ergonomic factor. The new invention of the flexible chair will also avoid the musculoskeletal disorders (MCDs). The problems such as back pain, shoulder, arm and many more can be avoid when the problems have been overcome.

The products will also be more comfortable. The product is more flexible whether for thin, fat, long, short and both genders students. This mean that, all student can seat at the writing table chair and feel more comfortable compared to the previous chair. So, the student can pay more attention or concentrate during lecture session. The problem such as bad posture and poor seating will be not occurred anymore.

The writing table chair also will be more stable, safe and sustain compared to the previous product. When these requirements were achieved, the students will be more focused and not sleepy during the lecture or lab sessions. So, the results of the students will be increased.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Overview**

The purpose of this study is to study the ergonomic factors of a writing table chair for left handed student. In this chapter, the summarization of the past studies was done. The summarization was done from the journals, articles, thesis, and books which have been written by the researchers from around the world. The literature review should highlight the theories, methodologies, and findings from the previous research which has been done by the researchers.

#### **2.2 Seated Work and Chair Design**

To reduce the rate and severity of low-back pain in seated work, workplace designers must pay special attention to the design of seats. A properly designed seat can support a person adopt a less strainful posture and reduce a loads placed on the spine. Several seat-design parameters are effective in achieving this purpose, including the backrest inclining angle, lumbar support, and arm rest.

Backrest is effective in reducing low-back stress. The important parameter of back rest design is its inclination angle, which is the angle between the backrest and the seat surface. A 90° back-inclining angle (a seat with a straight back) is inappropriate because

it forces person to adopt slumped posture. An increase in backrest inclination results in an increase in the transfer of body weight to the backrest and a reduced disc pressure.

The backrest should also have a pad in the lumbar region (called a lumbar support) which can greatly reduce the low-back stress because it helps a seated person maintain lordosis. Lumbar support is particularly important when the back inclination angle is small. The thickness of lumbar support should be about 5 cm. it is desirable, however, that the lumbar support is adjustable in height and size to maximize the comfort for people of different sizes.

Arm rests can help support part of the body weight of a seated person and thus reduce the load on the spine. Properly adjusted seat height, use of cushioned seat surfaces, and adequate leg space can all help reduce back stress. Further it should be emphasized that no matter how well seats are designed, a person should not adopt a static sitting posture for long. Sedentary workers should have regular breaks in which they should stand up and walk around. (Christopher D. Wickens, 2004)

### **2.2.1 The Design of the Present Chair**

The figure above was the design of the present writing table chair that was used at the Universiti Teknikal Malaysia Melaka (UTeM). This chair was used at almost more 95 percent of the whole university classroom.



Figure 2.1: Current writing table chair

After the sample chair was selected, the dimensions of the chair were taken. The dimensions of the chair are:-

**Back Size:** 18" (450 mm) W x 13" (325 mm) H

**Arm Height:** 9" (225 mm) H from Seat; 26" (650 mm) H from Floor

**Seat Size:** 18" (450 mm) W x 13" (325 mm) D

**Seat Height:** 17" (425 mm) H

**Material:** PVC and steel

The chairs are objects with a soul, not only because they correspond to our physiology with their legs, seats and backs or because they nurture us with their form and comfort but also because they possess an inner, well-conceived technology. However, the fact was rarely recognized that this technical construction is also a component conspicuously related to the design itself.

The standard further states that the establishment of a strict criterion for maximum seat depth is difficult due to the large variation in buttock–popliteal length of the large male and the small female. Hong Kong population anthropometry is outdated but available from two sources (Pheasant, 1994). The differences between the two are somewhat small. Stainless-steel bars of 80 mm in diameter are quite common in Singapore to encourage people to sit in a more relaxed sitting posture (Howe and Yong, 1997). The design criteria for supporting the buttocks seem to be quite extreme. Even for a given population, there is no consistent criterion for determining seat depth.

The problem, however, is that people rarely using the adjustable features of their chairs because they're not aware of them (Sanders and McCormick, 1992). One reason why people are reluctant to adjust their furniture is that the adjustments are not always easy. Moreover, adjustable furniture often has limited adjustable parts and is expensive. Lueder (1986) provides the following guidelines for making adjustments easier:

- Controls should be easy to reach and adjust from the standard seated position.
- Labels and instructions on furniture should be easy to understand.
- Controls should be easy to locate and use.
- Controls should produce the desired results.
- Minimal movement should be required to use the controls.
- Adjustments should require the use of only one hand.
- Tools should not be necessary. (Lueder, 1986)

The development and distribution of adjustable tables and chairs with the aforementioned functions are essential for maintaining good posture which promotes better learning. Nuttall (1999) reported that adjustable school furniture promotes good posture and enhances a student's intellectual development. The market demand for such furniture is expected to grow rapidly.

The objective of this study is to design an writing table chair for students using the guidelines provided by Lueder (1986), and evaluate their suitability based on their adoptability as compared with dimensions provided by the ISO 5970 (Standards for tables and chairs for educational institutions). The study was also done to establish the final adjustment range, and determine its practicality based on the results of the fitting trials.

### **2.2.2 Design goal**

The users should be able to work effectively in their environment oblivious to the concurrent data collection. The data acquired should enable the researcher to view seated time lengths and back recline activity of the user. It also should provide information

about lumbar use of the chair and common armrest location, while reducing human intervention to a minimum.

McCormick and Tuburgen (2003) stated that to ensure an optimal design, the monitor system should adhere to the following criteria:

- (1) Provide continuous measurement,
- (2) Collect information in real time,
- (3) Be inconspicuous in design,
- (4) Be easy to retrieve collected data.

### **2.2.3 Design Adoptability and Criteria**

The ISO 5970 distinguishes the size mark from 0 to 6 depending on the average body height to determine the appropriate size for tables and chairs. According to this international standard, the seven sizes for seating and related tables meet the seating requirements in all educational institutions. Therefore, the design adoptability, according to this study, ranges from size mark 0–6 of the ISO 5970 in relation to the average height of a user between 900 and 1800 mm.

The most critical design criteria for the prototypes of the writing tables and chairs in this study was creating ergonomic designs to compensate for the problems of existing adjustable tables and chairs. This study also considered the most significant problems stated by Sanders and McCormick (1992): “Adjustments are not easy” and “people do not usually bother to adjust their seats. An average user could become overwhelmed by all the possible adjustments that could be made.” The study attempted to reduce the inconvenience caused by the structural faults by minimizing the added adjustable parts. The following supplementary design criteria were also added:-