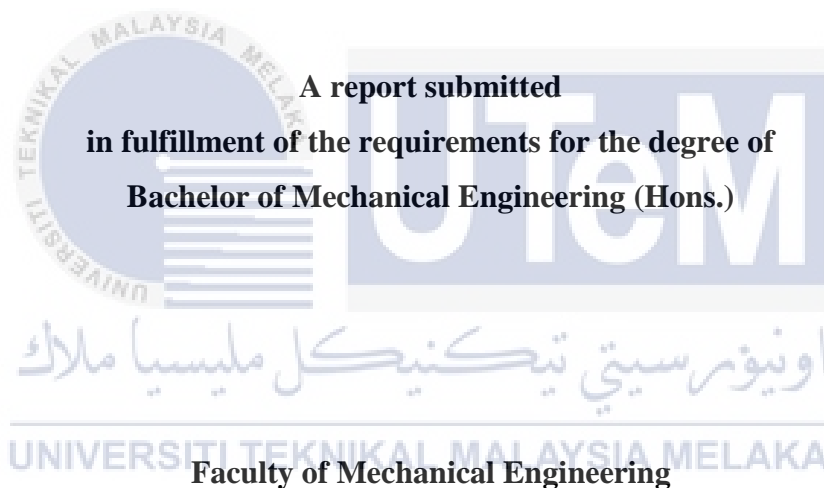


**EVALUATION OF ERGONOMICS WORKSTATION IN
UTeM LAMAN HIKMAH LIBRARY**

MUHAMMAD ANWAR BIN ABDUL AZIZ



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I declare that this project report entitled “Evaluation of Ergonomics Workstation in UTeM Laman Hikmah Library” is the result of my own work except as cited in the references

Signature :.....

Name : Muhammad Anwar bin Abdul Aziz

Date :.....



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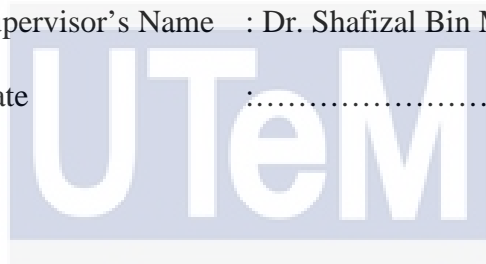
APPROVAL

I hereby declare that I have read this project and in my opinion this report is sufficient in terms of scope and quality for the quality for the award of the degree of Bachelor of Mechanical Engineering (Hons).

Signature :

Supervisor's Name : Dr. Shafizal Bin Mat

Date :



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DEDICATION

For my beloved parents who are always supported me:

Abdul Aziz Bin Hj Mohd Yusof

Zaharah Binti Omar

For My Supervisor,

Dr. Shafizal Bin Mat



ABSTRACT

Ergonomic is defined as the application of science concerned with the design and arrangement of objects that people use for people and things to interact more efficiently and safely. The learning environment, including lighting, temperature, workstation design, and others, can also affect users' comfort and health. Poor workstation design can result in injuries or related problems like musculoskeletal disorder (MSDs). The main objective of this project is to apply the ergonomic assessments (Temperature, illuminance, humidity and space) in the Laman Hikmah Library. The questionnaire is chosen method for gathering the information Laman Hikmah. The researcher also focused on evaluating the pattern and its compatibility with existed designs with ergonomic guidelines. Rapid Upper Limb Assessment (RULA) was also applied in this project to evaluate the computer workstation in Laman Hikmah Library. This assessment was conducted by using CATIA software. Some assessments (temperature assessment, humidity assessment, and illuminance assessment) indicate that the library and furniture were comfortable for Laman Hikmah users. However, ergonomic awareness among the Laman Hikmah Library needs further improvement. Evaluation ergonomic in the workstation library can improve awareness about ergonomic among Laman Hikmah Library.

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ABSTRAK

Ergonomik ditakrifkan sebagai aplikasi sains yang berkaitan dengan reka bentuk dan susunan objek yang digunakan orang untuk orang dan perkara untuk berinteraksi dengan lebih cekap dan selamat. Persekitaran pembelajaran, termasuk pencahayaan, suhu, reka bentuk stesen kerja, dan lain-lain, juga dapat mempengaruhi keselesaan dan kesihatan pengguna. Reka bentuk stesen kerja yang buruk boleh mengakibatkan kecederaan atau masalah yang berkaitan seperti gangguan muskuloskeletal (MSD). Objektif utama makalah ini adalah untuk menerapkan penilaian ergonomik (Suhu, pencahayaan, kelembapan dan ruang) di Perpustakaan Laman Hikmah. Soal selidik dipilih kaedah untuk mengumpulkan maklumat Laman Hikmah. Pengkaji juga memberi tumpuan untuk menilai corak dan kesesuaiannya dengan reka bentuk yang ada dengan garis panduan ergonomik. Rapid Upper Limb Assessment (RULA) juga diterapkan dalam makalah ini untuk menilai stesen kerja komputer di Perpustakaan Laman Hikmah. Penilaian ini dilakukan dengan menggunakan perisian CATIA. Beberapa penilaian (penilaian suhu, penilaian kelembapan, dan penilaian pencahayaan) menunjukkan bahawa perpustakaan dan perabotnya selesa untuk pengguna Laman Hikmah. Namun, kesedaran ergonomik di Perpustakaan Laman Hikmah perlu diperbaiki lagi. Penilaian ergonomik di perpustakaan stesen kerja dapat meningkatkan kesedaran mengenai ergonomik di kalangan Perpustakaan Laman Hikmah.

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Thousands of thanks to my supervisor, Dr. Shafizal Bin Mat, for giving me a chance to do my project under his supervise. I would like to show gratitude for his patient assistance and his invaluable support.

Furthermore, I would like to convey my sincere appreciation to my parent for their prayers and for supporting me physically and mentally



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LIST OF ABBREVIATIONS

UTeM	Universiti Teknikal Malaysia Melaka
MSDs	Musculoskeletal Disorder
ERF	Ergonomic Risk Factor
SH	Seat Height
SW	Seat Width
SD	Seat Depth
PH	Popliteal height
HB	Hip breadth
BPL	Buttock Popliteal, Length
UEBR	Upper Edge of Bracket
LEBR	Lower Edge of Bracket
HBR	Height of Backrest
WBR	Width of Bracket
SH	Shoulder Height
SSH	Subscapular Height
LH	Lumber Height
DH	Desk Height
DW	Desk Width
RULA	Rapid Upper Limb Assessment
CATIA	Computer Aided Three-Dimensional Interactive Application
FYP	Final year Project

CHAPTER 1

INTRODUCTION

1.1 Background

Laman Hikmah Library is suitable place for the user to study because of the quiet environment and comfortable place. The library is seen as an "informal place for learning," unlike the classroom, a formal place for learning (Montgomery, 2014). There seems to be great problems of ergonomic in the library environment. Since a comprehensive analysis occurs, the literature on ergonomic and libraries contained in books, journal and references from the internet (Bellemare *et al.*, 2006). In order to apply the ergonomic in library workstation, the definition of ergonomic must be understood.

Typically, ergonomics is related to humans and their jobs. However, on a broader scale, Ergonomics analyses humans' behavioural, psychological, and physiological capabilities and limitations (Jaffar *et al.*, 2011). Ergonomics is a comprehensive subject that encompasses a range of aspects that can impact a worker's comfort and health, including lighting, noise, temperature, vibration, heavy lifting, repetitive motion, workstation design, tool design, machine design, chair design, and footwear design, among others (Jaffar *et al.*, 2011). Next, musculoskeletal disorder (MSDs) causing pain in the hands, arms, shoulders, neck, back legs or feet while Musculoskeletal Disorder involving muscles, bones, tendons, nerves or other soft tissues (Santos *et al.*, 2014).

1.2 Problem Statement

The incompatibility of furniture dimensions with user's anthropometry is the one of the problems in this paper. It is because of the lack of concern on ergonomic in the workstation. This problem can make some health problem such as musculoskeletal disorder (MSDs). 90% of the older impaired workers have MSDs (Yelin *et al.*, 1999). Therefore, ergonomic research can help detect poorly built furniture that does not suit the user's anthropometric features that have a negative effect on human health.

Laman Hikmah Library provide the computer workstation for the user. A standard computer or laser printer produces nearly the same heat as a person. Overheat and lack moisture can induce drowsiness, irritability, itching of the skin, eruptions and dryness or irritation of the eyes (Thibodeau and Melamut, 1995). Lighting in workstation also contributed the glare problem and need to evaluate.

Finally, ergonomic awareness of Laman Hikmah Library user need to determine. Some user spend a long period in the library to find some resources and information. Lack of ergonomic awareness will result in head position in an awkward posture, neck and upper extremities. Thus, making the pressure on the soft tissues against external workstation increased (Yuan, 2015).

1.3 Objective

The objectives of this project are as follows:

1. To evaluate the design of a workstation that effect on fatigue, safety and performance of user at Laman Hikmah Library.
2. To conduct the ergonomic assessment for library design at Laman Hikmah Library workstation.
3. To analyse user posture using Rapid Upper Limb Assessment (RULA) at computer workstation in Laman Hikmah Library.
4. To investigate the awareness about ergonomic in Laman Hikmah Library.

1.4 Scope of Project

The scopes of this project are:

1. Analysing and evaluate the ergonomics assessments such as temperature assessment, space assessment, arrangement assessment and light assessments.
2. Focus on compatibility of posture by using RULA method at computer workstation.
3. Proposed the ergonomic library environment form assessment for Laman Hikmah Library that meets ergonomic criteria.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review is a theoretical background or the foundation of the project. In this chapter, it will discuss the material from the literature review that has used for the study. In order to obtain the crucial information, the review was conducted to achieve the objectives of the study that has been determined.

The review of literature on workers' ergonomic condition in related database such as Google Scholar, Science Direct, etc. There many investigations about ergonomic in the industrial workplace due to work in industrial at high risk of musculoskeletal disorder. However, this report to focus on library workstation which is Laman Hikmah Universiti Teknikal Malaysia Melaka (UTeM). Besides that, this chapter also includes information about Rapid Upper Limb Assessment (RULA). The information about anthropometric measurement will be include in this chapter. Lastly, the conclusion is the last subpart in this chapter that summarizes the whole chapter of literature review in this study.

2.2 Laman Hikmah

Since 10 June 2001, The UTeM Library has been operate in serving 348 pioneer students at the Temporary Campus in Taman Tasik Utama, Ayer Keroh, Melaka. Laman Hikmah Library at the Main Campus with 10,063.68 square meters provides a seating capacity of 500 users at any one time (utem.edu.my, 2015).



Figure 2.1: Location of Laman Hikmah Library

Figure 2.1 shows that Laman Hikmah location is the place to do some research in evaluating the ergonomics. The address of Laman Hikmah is Hang Tuah Jaya, 76100 Durian Tunggal, Melaka.

2.3 Ergonomic

Ergonomic come from the words ergo, a Greek word meaning “work” and nomics, meaning as “study” (Te-Hsin & Kleiner, 2001). From the definition, ergonomics is important to study the capabilities of human relating to work demands. Therefore, there is variety definition of ergonomics used by numerous researchers. Below are the definitions of ergonomics stated by previous researcher. Practicing good ergonomics has many advantage.

Based on Middlesworth (2013) the advantages of ergonomics are:

1. Ergonomics improves productivity of workers:

It will also increase the productivity of the staff by designing the efficient workstation that makes a job for good posture, less effort, less movements and better height and reaches.

2. Ergonomics help to improves quality:

The quality of the product will reduce if the ergonomics of their workstation is poor. Then, the worker cannot do their best work due to frustrated and

fatigued. Therefore, optimizing an ergonomics workstation is important to workers because it can help to improve the quality of the product produced and increase the performance of the worker.

3. Ergonomics help to improve employee engagement:

By making the best possible effort to provide their workers with the best health and safety. It can also decrease turnover, decrease absenteeism, enhance productivity and increase employee performance and during their workday the employee does not experience any pain and discomfort.

4. Ergonomics can create a better safety culture:

To get better human performance in organization by creating and fostering the safety and health culture in the company because healthy employees are most valuable asset.

2.4 Ergonomic risk factor (ERF)

In safety concepts and in applied ergonomics literature, risk and risk factors are common topics. Risk contains an element of how likely or likely an event is and the seriousness of the impact or severity if something occur (Jaffar *et al.*, 2011). The seven types of The Ergonomic Risk Factor (ERF) which are:

- a) Awkward posture: Muscles, tendons and ligaments must work harder and might be pressured in an awkward posture. An awkward posture arises when any joint bends or twists significantly outside the comfort of the movement (Jaffar *et al.*, 2011).
- b) Force: Can be described as the amount of physical work needed to carry out a task (e.g. lifting) or to maintain control of equipment or instruments. Exerting force on a person or item can cause our muscles and tendons to become overworked.

- c) Repetition: The repetition rate of a joint or a body link is indicated as the average number of movements or exertions completed within a unit of time or the repetition of identical motions with the same body part with little rest or recuperation (Jaffar *et al.*, 2011).
- d) Vibration: Vibrations occur when an object oscillates or moves rapidly around its fixed point, like a swinging pendulum (Jaffar *et al.*, 2011).
- e) Contact stress: Contact stressors occur when you work with forearms or wrists on the edge of a desk or counter (Jaffar *et al.*, 2011).
- f) Extreme temperature: Extreme temperatures can be classed into two extremely cold and extremely hot temperatures. Cold temperature can be determined by reducing manual dexterity and emphasizing the nerve end symptoms (Jaffar *et al.*, 2011).
- g) Static load: Our body is designed to move, not to keep passive. It is uncomfortable and fatigued to keep any position of the body for longer durations without modification (Jaffar *et al.*, 2011).

2.5 Ergonomic of library workstation

Adam (2010) found in this study, stretch, pressure, headache are the ergonomic problem happen due to the condition in librarians, library stuffs and system engineers in Logos and Covenant University. Instead, most related ergonomic research either focuses on evaluating ergonomic risks for library users or only looks at how librarians set up their computer workstations. Human factors and ergonomics are often ignored by libraries when designing electronic information services' hardware and software implementations (Thibodeau and Melamut, 1995).

2.6 Library space study

It requires understanding how students learn to facilitate their learning in the space they choose when creating the space. One of the main functions that define library space, according to Anuta Nitecki's article, is the job of the facilitator. The library fulfils this purpose by providing areas that "promote self-directed study." as well as the generation of new knowledge" (Montgomery, 2014).

2.7 Illumination study

Different lighting conditions can affect the scale and precision of visual perception, which can affect task performance. Artificial illumination's primary goal is to allow individuals to complete tasks in a comfortable, simple, and timely manner (Montgomery, 2014).

2.8 Thermal comfort

The influence of external elements and subjective responses towards the reported thermal condition make predicting optimal values of comfort parameters in automobiles problematic, as this particular environment is influenced by a number of additional aspects compared to buildings (Danca *et al.*, 2016).

2.8.1 Current standard of thermal comfort

The current standard that assessing thermal comfort building was The European EN ISO 7730 and is based on the theory of Fanger. During assessment, the person were exposed to various thermal conditions and the subject had standard clothes performing a standard activity (Danca *et al.*, 2016). By using ASHRAE scale with seven values (-3; cold,-2; cool,-1; slightly cool, 0; neutral, 1; slightly warm, 2; warm, 3 hot) the subject has been assessed according to the felt sensation.

2.9 Relationship between library and anthropometric measures

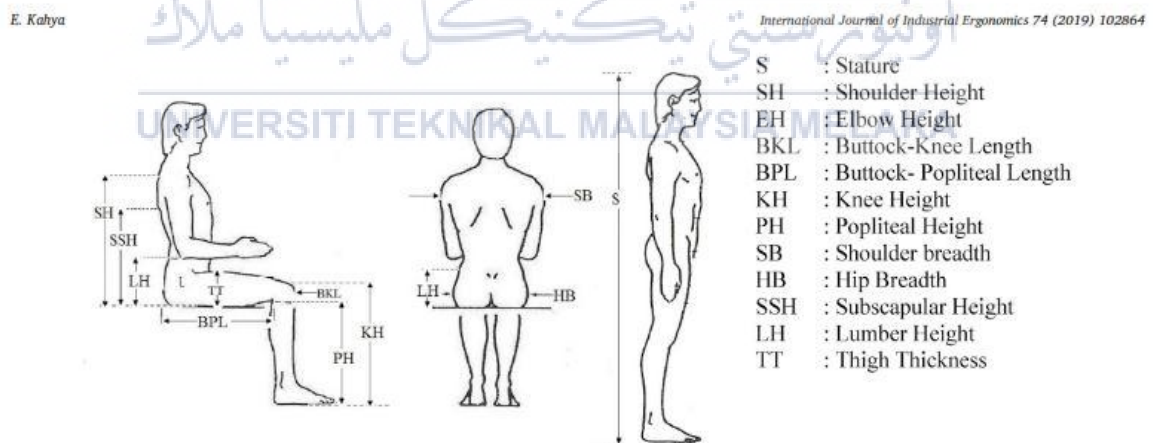


Figure 2.2: Anthropometric measures (Kahya, 2019).

Figure 2.2 shows the anthropometric measures that have to focus on this project. There are 12 anthropometrics measures: stature, shoulder height, elbow height, buttock-knee length, buttock-popliteal length, knee height, popliteal height, shoulder breadth, and hip breadth, subscapular height, lumber height, and thigh thickness.

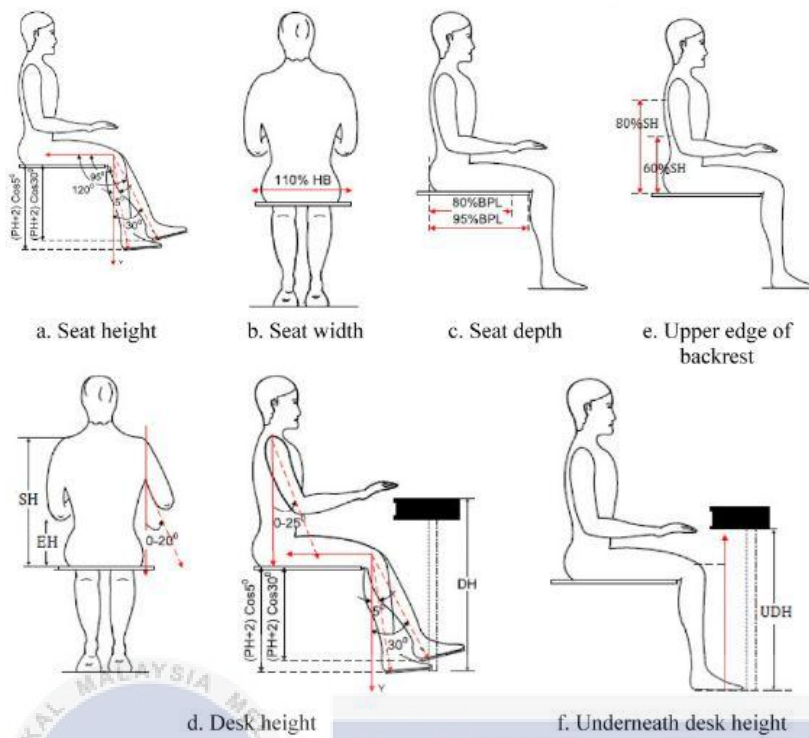


Figure 2.3: Relationship between anthropometry and library furniture dimensions (Yanto, Lu and Lu, 2017).

Figure 2.3 shows the correlation between anthropometry and library furniture, which is the chair and desk. This illustration can be an indicator of the project during the measuring session. In Figure 2.3, all anthropometric measures used in this study are seat height, seat width, seat depth, the upper edge of the backrest, desk height, and underneath desk height.

Table 2.1: Relation between library furniture and anthropometric

Section	University Library furniture dimension	Anthropometric measures
Seat	Seat height (SH)	Popliteal height (PH)
	Seat Width (SW)	Hip breadth (HB)
	Seat Depth (SD)	Buttock- popliteal length (BPL)
Backrest	Upper Edge of Backrest (UEBR)	Shoulder Height (SH)
	Lower Edge of Backrest (LEBR)	Lumber height (LH)
	Height Backrest (HBR)	Lumber height (LH)
	Width Backrest (WBR)	Shoulder breadth (SB)
Desk	Desk Height (DH)	Popliteal height (PH)
		Elbow Height (EH)
		Shoulder Breadth (SH)
	Desk Depth (DD)	Functional Criteria
	Desk Width (DW)	Functional Criteria
	Underneath Desk Height (UDH)	Seat Width (SW)
		Knee Height (KH)
Interaction	Seat to desk clearance (SDC)	Thigh Thickness (TF)
		Knee Thickness (KH)
	Seat to Desk Height (SDH)	Elbow height (EH)

2.10 Equation for mismatch by past researcher

2.10.1 Seat Height (SH)

It shows from Figure 2.3 the height of the seat must be higher than $[(PH+2) \cos(30^\circ)]$ to make sure the formation of angle of the leg in an angle less than 30° relatively to the vertical. From that, student would sit comfortably while the thighs have sufficient support. Then, the seat will less than $[(PH+2) \cos(5^\circ)]$ for the maximum, the student's feet must have proper contact with floor and in order to prevent pressure from existing in the tissue on the underside area of the thighs (Yanto, Lu and Lu, 2017).

$$(PH + SC)\cos 30^\circ \leq SH \leq (PH + SC)\cos 5^\circ \quad (1)$$

2.10.2 Seat width (SW)

SW should be at least 10% (to suit hip breadth) and at most 30% (economy of space) higher than HB in Figure 2.3, recommended by Gouvali and Boudolos (2006) which is determined by equation (2):

$$1.10 \text{ HB} \leq \text{SH} \leq 1.30 \text{ HB} \quad (2)$$

2.10.3 Seat depth (SD)

Mismatch when SD is either > 95% or < 80% of BPL in Figure 2.3 stated by (Parcells, Stommel and Hubbard, 1999). It can determined in equation (3):

$$0.80 \text{ BPL} \leq \text{SD} \leq 0.95 \text{ BPL} \quad (3)$$

2.10.4 Upper edge of bracket (UEBR)

Gouvali and Boudolos, (2006) recommend that in order to keep the backrest lower than or at most on the upper edge of scapula which is 60%-80% shoulder height (SH) in Figure 2.5.2. It can show in equation 4:

$$0.60 \text{ SH} \leq \text{UEBR} \leq 0.80 \text{ SH} \quad (4)$$

2.10.5 Lower edge of bracket (LEBR)

Based on (Gouvali and Boudolos, 2006), that UDH should be at least 2 cm higher than knee height (but not higher than desk height plus its thickness). It will be assumed 2 cm for table thickness and determined in equation 5:

$$\begin{aligned} & (\text{KH} + \text{SC}) + 2 \leq \text{UDH} \\ & \leq (\text{PH} + \text{SC}) \cos 5^\circ + 0.8517 \text{ EH} \\ & + 0.1483 - 2 \end{aligned} \quad (5)$$