ERGONOMIC ASSESSMENT FOR CLASSROOM DESIGN IN FKM UTEM

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A report submitted
in fulfillment of the requirement for the degree of
Bachelor of Mechanical Engineering (Hons.)

Faculty of Mechanical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2020

DECLARATION

I declare that in this project report with title “Ergonomic Assessment for Classroom in FKM UTeM” is the authentic result of my work excepts cited in the references.

Signature : …….

Name : …….

Date : …….

APPROVAL

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

Signature : .....

Supervisor's Name : DR. SHAFIZAL MAT

Date : 27. 8. 2020

DEDICATION

This report is dedicated to all of my lecturer of FKM faculty – past and present. My supervisor that have thought and guide me many things that don't know, Dr Shafizal. To my panel Dr Faiz Redza and Dr. Abdul Rahman who point my mistake during the presentation and also for their advice. I also want to dedicated to my family and friend members who supported me while I researched and wrote the report. Fahmi, Amir, Hasan, Azrul, Azhar, Mom, Dad – thank you all. I'm grateful for your support.

ABSTRACT

This report presents the ergonomic features of FKM classroom and its compatibility for FKM students who use the design during the class. The objectives of this report are to identify ergonomic design variabilities at FKM classroom, analyses FKM's student posture when using classroom chair, and evaluate and comparing the ergonomic assessment between FKM, FKE, FKEKK, FKP, and PBPI. Research only focused on evaluate the pattern and its compatibility between existed design with the suggested ergonomic standards. The surveys and questionnaire have been carried out among FKM student to acknowledge their feedback about the classroom design, surrounding comfort and the furniture design. Besides that, the anthropometric measurement and chair dimension are taken to obtain the data about the match and mismatch between students' size and existed chair design. Also, ergonomic classroom environment form has been filled for other faculty to compare with FKM classroom in term of classroom lighting, chair features and classroom spacing. Data collection using human observation methods and manual calculations. Rapid Upper Limb Assessment (RULA) was use to validate the result obtain by the manual calculation. The RULA analysis was perform by CATIA software. The conclusion obtained can be use as guideline for improving further design to ensure the student does not feel discomfort and experience Musculoskeletal Disorder (MSDs).

ABSTRAK

Laporan ini membentangkan ciri-ciri ergonomik kelas FKM dan keserasiannya untuk pelajar FKM yang menggunakan reka bentuk ketika pembelajaran. Objektif laporan ini adalah untuk mengenalpasti rekabentuk ergonomic yang boleh diubah, analisis postur badan pelajar FKM Ketika menggunakan kerusi bilik darjah, dan menilai dan membandingkan penilaian ergonomic antara FKM, FKE, FKEKK, FKP, and PBPI. Penyelidikan tertumpu pada menilai corak and kesesuaian wntara rekabentuk tersedia dengan standard ergonomic yang dicadangkan. Tinjauan dan soal selidik telah dilakukan di kalangan pelajar FKM untuk mengetahui maklum balas mereka mengenai reka bentuk bilik darjah, keselesaan di sekitarnya dan reka bentuk perabot. Selain itu, pengukuran antropometri dan dimensi kerusi diambil untuk mendapatkan data mengenai kesesuaian dan ketidaksuaian antara ukuran pelajar dan reka bentuk kerusi yang ada. Juga, konfigurasi persekitaran kelas ergonomik telah diisi untuk fakulti lain untuk dibandingkan dengan kelas FKM dari segi pencahayaan bilik darjah, ciri-ciri kerusi dan ruangan bilik darjah. Pengumpulan data menggunakan kaedah pemerhatian manusia dan pengiraan manual. Rapid Upper Limb Assessment (RULA) digunakan untuk mengesahkan hasil yang diperoleh dengan pengiraan manual. Analisis RULA dilakukan oleh perisian CATIA. Kesimpulan yang diperolehi boleh digunakan sebagai garis panduan untuk memastikan pelajar tidak merasa tidak selesa dan mengalami Musculoskeletal Disorder (MSDs).

ACKNOWLEDGEMENT

All praise to Allah who give me ability and health to move and doing my work of this project. Without His permission I would not be able finish the task successfully. Not forget my beloved family especially my parent who believe in my work support externally and internally. A special thanks for my supervisor of this project who is also my academic advisor, Dr. Shafizal Bin Mat, who patiently answer my question and guide me from beginning till the end of my process of finishing this report.

I also would like to show my gratitude toward all my friends and lecturer who come and boost my strength whenever I feel lost and want to quit. I hope my one year research is worth not only for me but also for future use as reference in their study.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

RETILAP	Technical Regulations and Public Lighting
CAD	Computer-Aided Design
CFD	Computational Fluid Dynamic
FKM	Fakulti Kejuruteraan Mekanikal
FKE	Fakulti Kejuruteraan Elektrik
FKEKK	Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
FKP	Fakulti Kejuruteraan Pembuatan
PBPI	Pusat Bahasa dan Pembangunan Insan
RULA	Rapid Upper Limb Assessment
MSD	Musculoskeletal Disorders
ISO	International Standards Organization
PSM	Projek Sarjana Muda
UTEM	Universiti Teknikal Malaysia Melaka
PMV	Predicted Mean Vote

CHAPTER 1

INTRODUCTION

1.1 Background

Ergonomic is defined as a characteristic of an object or product concern with artful and composing things group use, so the user and product can interact efficiently, friendly and safely. Ergonomic mostly are referred to as human factors that apply to the product, tools, process, and system through physical interaction. This interaction is important as it helps rise up the human performance, technology, economic and the modern interface requirement. The functions of the ergonomic design are to protect human health, comfort, and safety when they are using tools and products. The component design of any product, machine, workspace, and equipment is to increase productivity, reduce the injury risk and maintain the comfort for worker and user. Ergonomics applies to design everything that has interaction between human including working spaces, sports, relaxation, well – being and security for individuals. In prescript to trim and minimize the risk of injury or harm, ergonomics aims to improve workplaces and environments (Kroemer Elbert et al.,2018).

Ergonomic design studies can be wide and various if it was concerned about the health, comfort, and safety to end-user. The design is used to align human limitations such as posture, body measurement, bodyweight, vision and hearing capacity toward the new concept design. If proper designs are not highlighting the ergonomics, potential harm can happen to humans, equipment and the environment. Ergonomics hazard is a physical factor that damages the musculoskeletal system such as muscle or ligament of the lower back, neck,

and nerve. Ergonomics hazards also include the awkward posture, large force, repetitive motion or short interval between activity. Even that problem can be overcome by using certain devices to help humanity but it better to redesign the concept of the product. Youth's teaching is a primary care of contemporary society.

Awareness and knowledge are crucial for the further improvement of raising immature group. The knowledge hand over via school bench and university desk (Dobreva and Vachinska, 2012). Poor worksite design results in being tired, hurt and frustrated for students and for teachers. This leads to a reduction of productivity level in students' activities and reduces of teaching effectiveness level in teachers' performance. It is more likely to cause long term problems result in the wrong ergonomic design inside the classroom. Musculoskeletal disorder is one of the problems that will arise later when the wrong working posture, product, and design are used repeatedly and rapidly. This must be avoided especially for student whom there are still young and have a long journey to being through.

1.2 Problem Statement

In a fundamental concept, the school or university is conceived as a place where teachers and students associated, which organized education is given, intentioned and looks to meet certain instructive, social and comprehensive guideline work (Dobreva and Vachinska, 2012). Children spending over 30% of their minute during school (Samuel et al, 2010). Be that as it may, to reach comply with each of the capacities, it is fundamental that the school must meet certain prerequisites which can offer assistance both understudies and instructors to performs superior.

Firstly, the posture body of the student when they are using the classroom furniture. The design of furniture must have these two criteria: comfort and safety in other words user-friendly. The bungle between students' anthropometric measurement and furniture measurement can influence classroom exercise such as writing, reading, and typing, cause torment within back, shoulders, neck, legs, and eye. Mismatches between the human anthropometric measures and gear apparatus and furniture also have the tendency of resulting in a decline in efficiency, distress, mishaps, biomechanical stretch, weakness, wounds, and aggregate injuries (Al-Hinai et al.,2018).

One common example of the item that must meet the ergonomic design is the chairs. The basic fundamental usefulness of an ergonomic classroom chair ought to fulfil students' desires such as relaxational, comfortable, spacious for writing and placing the bag, etc. In any chair plan, there needs to aesthetics highlight one hand and highlight related to consolation and unwinding are on the other hand. A chair client could recognise between the parameters that are related to consolation and unwinding effortlessly, but he/ she frequently finds it troublesome to recognize between the ergonomics highlight of the chair. For occasion, numerous ergonomics highlight is gathered to diminish distress in sitting are unclear since they cannot be seen (Al-Hinai et al.,2018).

Light projection also plays an important role in ergonomics design which can make the student feel comfortable to view, write and focus. The light resources such as from windows, bulbs, etc are usually applied because of the building design or because of client requirements. Indeed, there are a few strategies to think about light but there isn't a standardized strategy to encourage the elucidation of the result of such thinks about in Columbia. Indeed, the nation has specialized control and open lighting (RETILAP). Be that as it may, this run the show doesn't have an ergonomic approach (Rodriquez et al., 2015).

Besides that, the viewing angle also needs to be included in ergonomic design. The wrong angle of viewing can cause injuries in the neck area. This poor posture can further lead to neck pain. A alter within the vertical area of visual targets impacts both the vertical look point of the eyes comparative to the topic and the introduction of the head relative to the environment (Burges-Limerick et al., 1998).

Finally, inside the closed building, the environment comfort plays an important role especially when the building was built in the middle of cities. Luckily there is research that has been conducted using the latest software technology; CAD and CFD software. We can judge the optimal thermal comfort values. The re-enactment of the warm impact in rooms has been created diverse program which is utilizing the emphasis strategies of calculation, with the reason of rapidly finding and precisions ideal development arrangement for the warm consolation within the room's geometry (Jurco and Scurtu, 2019).

1.3 Objective

The reason of this study is to conduct the evaluation of the Faculty Mechanical Engineering classroom which focused on the ergonomic design. The study is to analyse and identify the ergonomic principle used in the classroom especially the furniture. Especially, the objectives are to:

1. To identify ergonomic design variabilities at the FKM classroom.
2. To evaluate and comparing the ergonomic assessment for classroom design at FKM, FKE, FKEKK, FKP and PBPI.
3. To analyses FKM student's posture when using classroom chair.

1.4 Scope of Project

This research only focusses on scope outline of:

1. Evaluate the pattern of the FKM classroom whether it was suitable with an ergonomic design that requires by the user to ensure that the requirement such as comfort, safety and environmentally friendly are fulfilled.
2. Focus on analysing the compatibility of posture, lighting, angle, and design of the furniture, equipment, and user of the classroom.
3. Propose and compare the ergonomic classroom environment form assessment for FKM with other faculties in UTEM which meets ergonomic criteria.

1.5 General Methodology

The methods and flows of works that get been utilised to accomplish this project objective are listed below as the summary of project flow work and will further be discussed in the incoming chapter:

1.5.1 Literature Review

Any research material such as book, journal, article, website, and webpage from the existed research with relatable topics will be used to gather the knowledge and information especially in area of ergonomic design, anthropometric dimension and postural. The information then will be pointed out and connect with other to obtain the solid conclusion about ergonomic assessment structure at the same time help new discoveries about ergonomic for later researchers.

1.5.2 Design Information Feedback

The study will also include data collection from user which are FKM students. The surveys are used to collect data about their feedback using the FKM classroom among targeted students. The questionnaire will be spread among the students using google form to gain information and comment from various user that have been use the FKM classroom furniture. The questions are divided into two sections: first, general question. Second, suggestions and comments.

1.5.3 Observation

The study also includes the data analysis through the observation around the FKM classroom. The furniture and area design will be measured to obtain real data reading. The parameter measure includes the spacing for movement, number of students per class for each session, chairs and anthropometric dimension. The anthropometric measurement divide into three categories which are small, average and big size. This study also includes the comparing between the best and applied ergonomic design with FKM classroom design.

1.5.4 Ergonomics Classroom Design Standard

The study is to obtain the standard parameter for comparing the existed design and suggested design concept. Even the information cannot be use for future change, at least it give the rough idea on how close the existed design compare with standard approach.

1.5.5 Classroom assessment

Classroom design will be study and evaluate in the assessment form for five faculty. The result obtain will be compared and the faculty with the highest scores will be benchmark for classroom design. It also gives information about the comparison between other faculties in term of ergonomic scoring.

1.5.6 Ergonomic Analysis using RULA Analysis in Catia

The analysis of the body posture for three position of an average student using CATIA software. The analysis is known as Rapid Upper Limp Assessment (RULA) is used to evaluate and making decision whether the design are suitable and low risk for student or need further change and improvement of the design to avoid any injury or pain when using it.

1.5.7 Final Report

Final report was written after all of the design evaluation and analysis works were successfully done and fulfil the project objectives. The report are organised in standard format before summited.

1.6 Organisation of Report

The project background, problem statement, objective, scope, and general methodology have been excerpted in this early chapter. The project background describes the overview of the project's research and covers the entire project introduction. The main

priority of this project is to achieve the project's objectives. The project scope explains the boundary and limitation area of the research. The further action, process, and approach are explained in general methodology.

The next chapter will discuss the literature review and methodology. Previous research and findings related to this project's topic will be filled in literature review. It will help further research and development as well as improve the proposed project design. While the methodology will act as a reference for the detailed explanation. The approach and process can be run smoothly as a methodology can be guideline for the project's progress schedule and for obtaining the necessary items. It also can help student to focus on certain task and keep on the track before the last date coming. The methodology is required to produce a systematically and orderly research plan to carry out the report's progress smoothly.

The result and discussion will be explained after methodology. This chapter will explain the result obtain from the information gathering from various resource. The result obtain will be utilise in order to make it understandable. The data are flexible and can be change within the student exchange and finished their study. The chair is redesign using Catia software without change the dimension as it is needed for postural analysis of existed chair design.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The knowledge about the ergonomic design and characteristic are obtained from the journal from previous research. The related issues are gathered up more than one journal to be compiled in this chapter. There is much information can be obtained from the literature review. Besides that, the uncomplete problem also can be solved by doing deep research and reading because everything is and must be connected toward each other.

2.1 Ergonomics

Concurring to Wilson (2000) characterized that ergonomics could be a teach in its claim right, as the hypothetical and essential understanding of human behaviour and execution in intentional connection socio-technical frameworks, and the application of that understanding to plan of intuitive within the setting of genuine settings.

Ergonomics is related to fitting work or study environment to bring maximum productivity and prevent health deficits. Well said, it also can improve well-being, grades, comfort and lower musculoskeletal disorder (Adje et al., 2019).

2.1.1 Ergonomic Chair Design

The research on the chair plan and building thought of the student's require and desire are not sufficient. An ergonomic chair plan must have extra highlights that are related to comfort utilization, support, consolation, strength, etc. Beside the student's issues, the chair plan moreover can contribute to understudy wellbeing issues related to body parts such as tendons, joints, and spine. Chair design also must include both aesthetic and comfort-relaxation related features. A user usually can identify parameters related to comfort and relaxation easily but difficult to identify the differences between ergonomic features. Unfortunately, ergonomic features that are assumed to soothe inconvenience in sitting are undefined since they cannot be recognized. There are numerous preferences when utilizing subjective and quantitative plan criteria such as diminishing formative lead-time and fetched, expanding client consolation and unwavering quality (Al-Hinai et al., 2018).

There are many patterns of chairs that differ in many ways. But the ergonomic chair design puts a priority on the weight distribution of the user. Thus, it brings the function for weight-bearing and body stabilization in undynamic and inducement way (Adje et al., 2019).

2.2 Overall Problem

Based on Dobreva and Vachinska (2012) state that the incorrect working furniture choice and arrangement may lead to various problems such as loss of concentration, starting of fatigue and weakness, distraction or need of changing the environment, reduce quality and speed of work and injuries.