

ERGONOMICS EVALUATION OF DESIGN STUDIO AT FKM UTeM

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DECLARATION

I declare that this project report entitled “Ergonomics Evaluation of Design Studio at FKM UTeM” is the result of my own work excepts cited in the references

Signature :

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APPROVAL

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

Signature :

Supervisor's Name :

Date :

DEDICATION

To my beloved father, Ahmad Khairi B. Yahya

and my mother, Hajjah Bt. Ahmat

ABSTRACT

Ergonomics is the way to plan or organize workplace environments structure and systems to fit the users so that any harmful pains will be reduced. Ergonomics applies to the design of everything including work areas, sports and relaxation, wellness and personal safety which promote health and safety and maximizing productivity. Attention to the principles of ergonomics helps to decrease accidents and disorders in the workplace, resulting in compensation expenses for employees, medical claims and loss of working time. The aim of this project is to design and analyse student's body posture at the workstation during studio activities by using CAD software design CATIA V5R20. It is used for 3D modelling and ergonomics analysis. In this project, there are three concepts that have been proposed and the selection method used to find out the best concepts for further detailed design in the next step. The best designs of the concept were selected based on criteria stated in the evaluation of Pugh Selection Matrix and Weighted Decision Matrix. Selection design was analysed using Rapid Upper Limb Assessment (RULA) to achieve the results of ergonomics analysis. The final ergonomics score indicates a score of 2 for the new selection model. The new selection structure guarantees that the user's body is in a secure and stable place to lower back, neck and hip joint stress.

ABSTRAK

Ergonomik adalah cara untuk merancang atau menyusun struktur dan sistem persekitaran tempat kerja agar sesuai dengan pengguna supaya sebarang sakit berbahaya dapat dikurangkan. Ergonomik diguna pakai terhadap reka bentuk semua termasuk kawasan kerja, sukan, kesejahteraan dan keselamatan individu yang menggalakkan kesihatan dan keselamatan dan memaksimumkan produktiviti. Fokus terhadap prinsip ergonomik membantu mengurangkan kemalangan dan gangguan di tempat kerja, menyebabkan perbelanjaan pampasan bagi pekerja, tuntutan perubatan dan masa bekerja. Tujuan projek ini adalah untuk merekabentuk dan menganalisis postur badan pelajar di stesen kerja semasa aktiviti studio dengan menggunakan reka bentuk perisian CAD CATIA V5R20. Ia digunakan untuk model 3D dan analisis ergonomik. Dalam projek ini, terdapat tiga konsep yang telah dicadangkan dan kaedah pemilihan digunakan untuk mengetahui konsep terbaik untuk reka bentuk terperinci lebih lanjut dalam langkah seterusnya. Reka bentuk terbaik konsep dipilih berdasarkan kriteria yang dinyatakan dalam penilaian Pugh Selection Matrix dan Weighted Decision Matrix. Reka bentuk pemilihan dianalisis dengan menggunakan Rapid Upper Limb Assessment (RULA) untuk mencapai keputusan analisis ergonomik. Berdasarkan skor ergonomik ianya menunjukkan skor 2 untuk model pemilihan baru. Struktur pemilihan baru memberi jaminan kepada pengguna agar sentiasa berada di tempat yang selamat dan stabil untuk leher dan pinggang.

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CHAPTER 1

INTRODUCTION

1.1 Background

Ergonomics commonly referred to as human factors that apply physiological principles to product, process and system design. Ergonomic issues can be related to a wide variety of concerns including workstation physical outline, work environment, tools, vehicles, computer programs and plant. Ergonomics aims at designing equipment, technical systems and tasks to improve human health, safety, comfort and results. Human components are aimed at reducing human error, increasing productivity, and enhancing safety and comfort with a focus on human interaction. Ergonomics is the way to plan or organize products and systems of working environments to fit the people who have used them. Ergonomics applies to the design of everything including working spaces, sports and relaxation, well - being and security for individuals. In order to reduce and minimize the risk of injury or harm, ergonomics aims to improve workplaces and environments (Kroemer Elbert et al., 2018)

Productive workspaces, which involve the design of a workspace with human capacity and limitation, including body measurement, sensory abilities (vision, hearing) and even attitudes (Gurr, K., Straker et al.,1998) hazard is basically the potential for harm or harm to people's health, loss of equipment, and environment. Ergonomic hazard is a physical factor that damages the musculoskeletal system within the environment.

Ergonomic hazards include issues such as uncomfortable workstation height, poor positioning of the body, extreme postures, repetitive movement, poorly designed tools, handling and physical environment. Hazards often result from the design of the space, which means that it is crucial to plan ahead and think about how employees interact with their workspace. The importance of ergonomic hazards depends after a period of time on the level of exposure. Injuries sustained from these risks can be anything from sore muscles to long haul diseases.

Poor worksite design results in students being tired, frustrated, and hurt. This rarely results in the students being the most productive. It is more likely to cause painful and costly injury, lower productivity and poor product quality. The physical outline of workstations and other equipment has a great pattern of ergonomics, which can affect the student's own health and productivity (Zetterberg, Heiden et al.,2019). The use of ergonomic workstations in the design studio environment is likely to lead to reduced body discomfort and a positive effect on performance. Users of workstations that are mainly students use similar workspace for each class they attend Their desk, chair and workspace design can be given specific ergonomic consideration.

1.2 Problem Statement

The most important consideration when designing the ergonomics design studio is individual started to develop several musculoskeletal injuries when using the computers in extended period of time and the cause was poor design of their workspace. There are few factors play a role in ergonomics, including body posture and movement (sitting, standing and pushing), noise, climate and vibration environmental factors, as well as organization of work scope. Many individuals do not understand that severe health issues can result

from a badly constructed computer workstation and/or poor job habit. Common symptoms connected with bad design or practices include back, neck and shoulders pain, hands and wrists, headaches and eye strain (Jeffrey R. Cram, I. Vinitzky, 1992).

For prolonged periods of time, the work needs individual to sit at the desk for several hours. Mainly sedentary days spent put individuals at risk for chronic pain, musculoskeletal disorders and accidents, all of which have an effect on long-term health and productivity (Candotti, Detogni Schmit et al.,2018) "Sitting disease" is a phrase lately created as fresh study indicates that sitting without proper posture and spine alignment for lengthy periods of time can lead to several long-term health circumstances, including musculoskeletal disorders. Poor work site layout results in individuals being tired, frustrated, and hurt. This rarely leads to the individuals being the most productive. More probably, it results in painful and costly injury, reduced productivity and bad quality of the product (Kroemer Elbert et al., 2018)

1.3 Objectives

The purpose of this study is to conduct the evaluation of Faculty Mechanical Engineering design studio which focuses on the ergonomics system. The study is to analyze and identify the ergonomics principle used in the design studio. Particularly, the objective is to:

1. To design and create ergonomics workspace of design studio by using computer software SketchUp.
2. To analyses student ergonomics body posture at workstation during studio physical activities.

1.4 Scope of Project

The project's scope outlined for this project are:

1. The design of ergonomics studio satisfies the safety requirement including not harmful to the users, considerable persistence and environmentally friendly by applying initial analysis on the design.
2. This project focus on analyzing body posture of individual at the workplace of design studio.
3. Design and analyze the conceptual design using Computer Aided Design software (RULA) and analytical software.

1.5 General Methodology

The method and flow of works that are used to accomplish this project is discussed on the next chapter. The actions needed to achieve this project's objectives are listed below:

1.5.1 Literature Review

Any material such as journal, book, article, website or video, will be used to gain knowledge of the existing research related to the particular topic and analyze the information that have been gathered to improve the research or project.

1.5.2 Method of Gathering Information

The study will also include data collection methods. The questionnaire collects the data. In answering these research questions, statically weighted decision matrix was used. The questionnaire designed for the study was subjected to the students especially on the ergonomics concept design of the studio.

1.5.3 Ergonomics Studio Design

The study will include the human - related ergonomics risk factors and their nature of work in order to gain a better understanding of the mechanism of ergonomics, parts, and any other information related to the subject. Class layout and size capacity shows the adequate amount allowed in a classroom or design studio.

1.5.4 Workstation Design

A simple workstation is created by using analytical software Sketch Up to achieve the objective. Analysis the movement and posture of individual is done by using suitable software Rapid Upper Limb Assessment analysis. RULA Analysis allows individual to choose optimize posture according to postural score. The final score will show an indicator score value of the ergonomics design whether it achieve the target or not.

1.5.5 Final Report

A final report was written after all of the design analysis works were successfully done.

1.6 Organization of Report

The project background, problem statement, goals, scope and general methodology were captured in this introduction chapter. The project background describes the entire project introduction. In this project, the most important thing is to achieve the project goals. The project scopes explain the project boundary and target users. This topic also covers the needs and content of this project. Output and approach used in this project are explained by the general methodology.

The next chapter will discuss on literature review and methodology. Previous research and findings related to this project will be described in the literature review. It will help to develop and improve the proposed project. In the meantime, the methodology will cover the selected approach to the development of this project as it helps to complete the project with the project's progress schedules and the necessary requirements. Methodology illustrates the method on how the ergonomic analysis is implemented. The methodology is required to produce a systematically and orderly research plan in order to smooth out the report progress.

Conceptual design is the first step in creating a new product in the multi-phase process. The conceptual design phase follows the schematic design characteristics and morphological chart helps to illustrate method and strategy in developing the concepts generation. For the engineering analysis chapter, selection design was analyzed using Rapid Upper Limb Assessment (RULA) analysis to achieve and obtain the result of ergonomics analysis. The result shows the individual work-value and final score of the conceptual design posture.

CHAPTER 2

LITERATURE REVIEW

2.1 Ergonomics

Ergonomics is the way to structure or organize work environments, products and systems to fit the people using them. Ergonomics or human variables as referred to in North America are part of science aimed at finding out about human capacity and constraints and then applying this understanding of how individuals can cooperate better with products, structures and environments. Ergonomics plans to improve workspaces and situations in order to reduce the risk of harm or damage (Kroemer Elbert et al., 2018). The need to make sure that as technology changes, the devices we access for work, rest and play are tailored to the needs of our body. An orderly ergonomics-enhancing process inspects hazard factors that result in injury to the musculoskeletal system and considers increased human performance and productivity (John R. Wilson, 2000).

Ergonomics is a combination of the words ergo, a Greek word meaning “work” and nomics, meaning “study” – the study of work. An applied science that coordinates the design of devices, systems and physical working conditions with the capacities and requirements of the workers (N. Jaffar et al., 2011). Ergonomics is intended to ensure maximum productivity at a minimum cost; in this context, costs are expressed as workers' physiological or healthcare costs. Only a large number of tasks in a working environment sometimes exceed most of the workforce's skills. There may be jobs that include a specific

task that requires extended reach or overhead work that cannot be sustained for long periods of time by using ergonomic standards to plan those undertakings, more people should be able to do the job without the risk of damage. Ergonomics has already been defined and the focus is primarily on the design, skills and limitations of the individual-friendly work activities (Karwoski,1991). The approach is to respond to an individual skill requirement to reduce the risk of manual handling and material handling of musculoskeletal wounds.

Martin Helander (2006) defined that ergonomics is rarely a goal in itself. Safety, operator satisfaction and productivity are common goals of ergonomics. Ergonomics is a design methodology that is used to arrive a safety, productivity and satisfaction, the safety status of a system may be assessed by comparing the performance requirements of the environment with the performance limitations of the operator.

2.1.1 Human Factors and Ergonomics (HFE)

Human variables and ergonomics are commonly known as human elements and the application of psychological as well as physiological standards to product, process and system design. Human elements are intended to reduce human error, increase productivity and improve safety and comfort, with a focus on human interaction. Human factors represent the health, safety and profitability objectives of the workplace. It is important to design things like safe furniture and easy to use interfaces for machines and appliances (Martin Helander,2006)

Suitable ergonomic design is necessary to prevent repeated strain injuries and other disorders of musculoskeletal injury that can develop over time and lead to long term disability (Chapanis, 1995). For an assessment of a person's fitness with the technology being used, human factors specialists and ergonomists consider both

the work being done (activity) and the needs of the user; the equipment being used (the size, shape and how it is suitable for the task). Ergonomics focuses on many disciplines, including visual design, user knowledge, biomechanical, mechanical engineering, industrial design and information design, in its study of humans and their environment.

Human elements and ergonomics relate to the user's fit, equipment and environment. It represents the user's capabilities and limitations to ensure user-friendly tasks, capabilities, information, and environment. Human factors specialists or ergonomists consider the work being done and the requirements of the user; the equipment used (size, shape, and how appropriate it is for the task) and the information used (how it is introduced, accessed, and changed) to assess the fit between an individual and the innovation used (Chapanis,1995). Ergonomics uses many orders, including mechanics, industrial engineering, information design and design, in its human and environmental studies.

2.1.2 Importance of Ergonomics Evaluation

In order to adapt them to the general public, ergonomics plan or organize work environments, items and frameworks. The vast majority have knowledge of ergonomics and believe that it concerns the structure of the workplace, sports and relaxation, well-being and safety, or the design of car controls and instruments. Ergonomics is a science that involves learning human capabilities and constraints and applying this knowledge in order to improve interaction between human beings and products, systems and environments. Ergonomics is designed to improve working spaces and environments to minimize the risk of harm or injury (Kroemer Elbert et al., 2018).