

Development of Transmission Jack Table as a Learning Innovation of Transmission Overhaul Practice to Reduce the Risk of Cumulative Trauma Disorders (CTDs) in Students

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Abstract—The purpose of this research is to produce a tool that serves to help hold, lift, and lift and place the transmission to unload. The tool is called a transmission jack table which is designed to reduce the risk of cumulative ergonomic trauma disorders (CTDs) suffered by student practitioners in the transmission overhaul practice of the automotive power train course. This design uses an ergonomics approach, starting with anthropometric measurements of students, designing using software and making prototypes, then testing and analysis using the Quick Exposure Checklist (QEC) method. The result of this study is to obtain a tool in the form of a transmission jack table and reduce the risk of cumulative ergonomic trauma disorders (CTDs) experienced by students. So that this learning tool has a good impact in reducing musculoskeletal complaints and reducing the risk of work accidents and increasing work productivity.

Keywords—*anthropometry, quick exposure checklist, musculoskeletal disorders, transmission jack tables*

I. INTRODUCTION

Education plays an important role in efforts to foster superior human resources to face all the challenges of today's world development. Of course, this must be supported by a safe and comfortable learning process in every activity carried out, especially in vocational education which mostly practices in workshops. Often when doing the practicum process, the practitioner is injured because of their presence and does not apply ergonomics knowledge in it. Ergonomics is the science of the interaction between humans, the objects they use, and their work environment [1].

The application of ergonomics is closely related to the power train course conducted by automotive concentration students in the sixth semester of the UPI Mechanical Engineering Education Study Program. In this course, the theory and practice of overhaul are studied regarding the mechanism of several components in a vehicle that work together to run power from engine speed to final drive, one of which is the transmission.

The transmission overhaul workstation begins by removing the transmission from the vehicle and lowering it using the transmission jack, followed by transferring the transmission from the transmission jack to the workbench by manual loading for work and development. Workstation conditions and work postures that are not good can pose a risk of musculoskeletal disorders.

This agrees with Dartt [2] explains reported a significant association between risk factors for physical work (awkward posture, strength, repetition, and vibration) and musculoskeletal disorders (MSD) of the upper extremities. This report also reports strong evidence of a causal relationship between awkward postures and neck/shoulder disorders and a combination of physical risk factors and upper extremity disorders.

Assistive devices can reduce the burden and risk of injury to musculoskeletal disorders [3]. The author's idea in this case is the use of transmission tools in the form of an electric jack, a tool design that combines the concept of a transmission jack and a workbench, so that helping, developing, and developing transmissions can be done in one workstation without the need to do manual load research again.

The design of the jack transmission table is a new and unprecedented tool. Substitution technique engineering is carried out on the transmission jack table by perfecting the process of using ordinary transmission jacks as an effort to control musculoskeletal complaints during transmission overhaul practices. The use of the transmission jack table does not completely avoid the risk of injury. This problem occurs due to several factors, one of which is the different body postures of students. Therefore, an analysis of student anthropometry is needed as a recommendation for repairing the transmission overhaul workstation.

The level of practice risk and recommendations for handling it can be analyzed using a quick exposure checklist

questionnaire to students during transmission overhaul. The Quick Exposure Checklist (QEC) is a method used to measure the risk of injury to the back, neck, shoulders, arms, and hands. This method was chosen because it is easy for inexperienced researchers to also consider the requirements of body parts needed in ergonomics research in transmission overhaul practices.

II. RESEARCH METHODS

This development research uses the ADDIE method developed by Dick and Carry, as the name implies, this model involves the following stages:

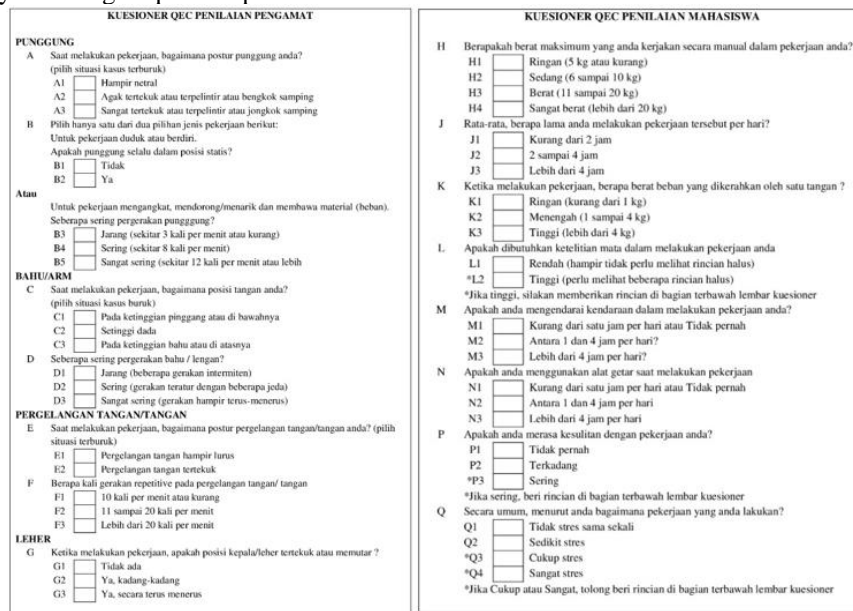


Fig. 1. Researcher and student QEC questionnaire.

After getting the exposure score of each member of the student body at the transmission overhaul workstation, the next step is to calculate the exposure level which is then used to find out what actions should be taken in relation to the observed workstation. Here is the calculation:

TABLE I. EXPOSURE LEVEL ANALYSIS BEFORE USING THE TRANSMISSION JACK TABLE

No of student	Student Exposure Level Description	
1	69.14%	Further research and changes made
2	69.14%	Further research and changes made
3	75.93%	Further research and changes soon

Li and Buckle [4] categorize the exposure level value of 69.14% obtained from students 1 and 2 is in the range of 50-69% and it can be interpreted that further research is needed and changes are made. The exposure level value of 75.93% obtained from student 3 is in the range of values >70% and it can be interpreted that further research is needed and changes are made as soon as possible.

Based on the results of the QEC analysis, that in the practice of transmission overhaul without using a transmission jack table, there are factors that influence the occurrence of stress and aches in the student musculoskeletal system, among others as described by Bridger [5] regarding the four main risk factors for the occurrence of musculoskeletal disorders. namely load, posture, frequency, and duration of work. The source of the high ergonomic risk during transmission overhaul is holding the load for a relatively long time, this occurs when removing the fastening bolts, releasing the transmission shaft input. Vice versa when installing the load will be very heavy, namely when lifting the transmission, fitting the transmission input shaft to the sleep clutch hub and when installing the transmission fastening bolts. By using a transmission jack table, lifting, and holding work is replaced by a tool, meaning that you no longer use hand muscles. Thus, the ergonomic risk decreases the exposure level to below 40% or is in the safe category.

III. RESULTS AND DISCUSSION

Complaints felt by students in the practice of transmission overhaul using a transmission jack table tool are caused by holding heavy loads for a long duration as well as awkward work postures and uncomfortable workstations. Therefore, we need a tool that can hold, lower, and lift the transmission at the time of removal (disassembly) and when installing (assembly). With the transmission jack table, this risk can be reduced, and the transmission jack table can be used as a workbench at the same time so that the practitioner no longer needs to lift the transmission to the table, this can cause the exposure level to decrease.

The following is a design and prototype of a transmission jack table made by researchers.

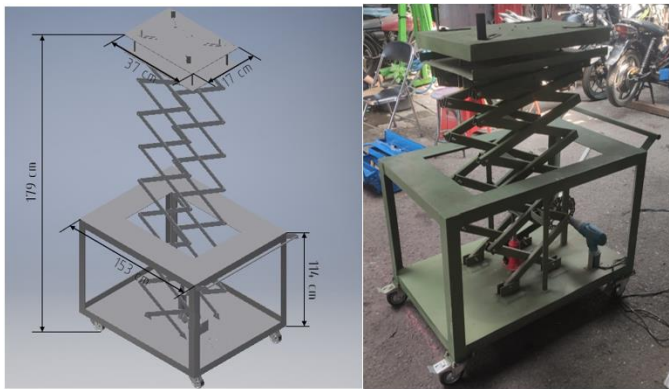


Fig. 2. Transmission jack table design and prototype.

Using this transmission jack table, students will feel more secure and comfortable during practice and can reduce the risk of ergonomics. The impact can speed up practice time, so that

time will be effective and efficient and increase work productivity.

IV. CONCLUSION

The cause of the high ergonomic risk shown by exposure levels above 70% is an awkward posture which causes pain and soreness in the practitioner's body due to holding, lowering, and lifting heavy loads with a long duration of time, neck too upturned, and arms reaching too high above shoulder height. With the use of the transmission jack table which functions to hold, lower, hold and lift the transmission, it can reduce the exposure level from the "Further research and immediate change" category to the "Safe" category.

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