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Ergonomic Multifunctional Building Tool Design to Increase Work Productivity of Msmes Employees

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Abstract: In culinary businesses that are members of MSMEs or small food processing industries, grating work is usually done manually. The tools used for grating are usually also simple. Sometimes grating work, such as grating coconuts, sweet potatoes, cassava, and so on, is done by paying for grating services. This is considered less effective and adds time and costs that continue to come out. Manual grating can also increase the risk of work accidents in the form of wounds on the hands, grating, or fatigue. Complaints in the arm muscles, it takes longer, causing less than optimal employee work productivity. Therefore, a shaving tool is needed Ergonomic multi-function as a solution to these problems. This research was conducted experimentally by making a multifunctional design tool that was applied to MSMEs employees in Tabanan Regency. Workload was calculated based on employee work pulse measured using a pulse meter, skeletal muscle complaints were measured using the Nordic Body Map questionnaire, work fatigue was calculated using 30 general fatigue questionnaire items and work productivity was calculated based on grater results divided by workload and working time. Test the difference between treatments using the t-pair test statistic at a 95% significance level. The results showed that the use of multifunctional shaving tools can significantly reduce workload, skeletal muscle complaints, and employee work fatigue. The use of this multifunctional contractor is also able to significantly increase employee work productivity. Therefore, it is recommended that this multifunctional contractor can be used for MSMEs engaged in culinary.

Keywords: Multifunctional Shrinking Tool, Ergonomics, Work Productivity

1. Introduction

Micro, small and medium enterprises or so-called MSMEs have a very important role in advancing and encouraging a country's economy. MSMEs in Indonesia have a very important role in encouraging economic growth. The existence of MSMEs can reduce unemployment caused by the non-absorption of the labor force in the world of work. The role of MSMEs which is so important for the Indonesian economy makes the Government of Indonesia continue to strive to support MSMEs to continue to advance. One of the Indonesian Government's supports is in the form of financial support and the completeness of raw materials through state-owned enterprises (SOEs), but this support is still unable to make MSMEs stronger. There are many types of MSMEs in Indonesia, ranging from crafts to culinary.

One of the MSMEs in Tabanan Regency Bali is MSMEs in the food or culinary sector. Food processing in the culinary business cannot be separated from the work of slicing, cutting, or grating food ingredients. In culinary businesses that are members of MSMEs or small food processing industries, grating work is usually done manually. The tools used for grated are usually also simple. Sometimes grating work such as grating coconuts, sweet potatoes, cassava, and so on is done by paying for grating services. This is considered less effective and adds time and costs that continue to come out.

Grating manually can also increase the risk of work accidents in the form of wounds on the hands, grating, or fatigue. Complaints in the arm muscles, it takes longer, causing less than optimal employee work productivity. Therefore, an ergonomic multi-functional contractor is needed as a solution to these problems.

There are many problems in the small industry that must be solved [1, 2]. One solution is by applying appropriate technology or known as the application of TTG [3, 4]. The appropriate technology applied must be user-oriented so that users can use the tool safely, comfortably, and productively. This is in accordance with the rules of ergonomics [5-7].

One tool that can be a solution to the problems of MSMEs in Tabanan district or elsewhere in terms of grating food ingredients such as coconut, sweet potato, cassava and other materials is the TTG tool which is designed as a multifunctional contracting tool. This multifunctional contractor needs to be adapted to the user's anthropometry so that the user can use it effectively, safely, comfortably and be able to increase his work productivity [8-12].

The purpose of this study is to provide solutions to employee problems and small industry problems, namely reducing workload and increasing employee work productivity with an ergonomic approach and the use of appropriate technology in the form of the use of ergonomic multifunctional equipment designs. Therefore, it is considered necessary to conduct this research.

2. Method

The method used in this study is an experiment using the design group within-treatment (same subject). Between the two treatment groups there was time washing out [13]. The research design can be described as follows.

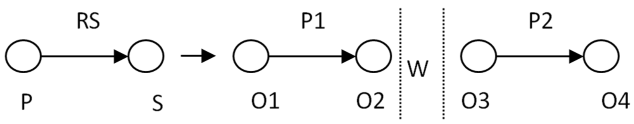

***Figure 1.** Research Design.*

Remarks: P = population
RS = simple random
S = sample
P1 = Treatment 1 (using the old way/manual shrinking)
P2 = Treatment 2 (traction using a multifunctional shrinking device)
WO = Washing Out for two days

The research sample was MSME employees in Tabanan-Bali Regency, Indonesia. Workload was calculated based on employee work pulse measured using pulse meter, skeletal muscle complaints were measured using Nordic Body Map questionnaire, work fatigue was calculated using 30 general fatigue questionnaire items and work productivity was calculated based on grater results divided by workload and working time. Test the difference between treatments using the t-pair test statistic at a 95% significance level.

3. Results and Discussion

3.1. Multifunctional Grating Tool Design

The design of the multifunctional contractor is as follows.

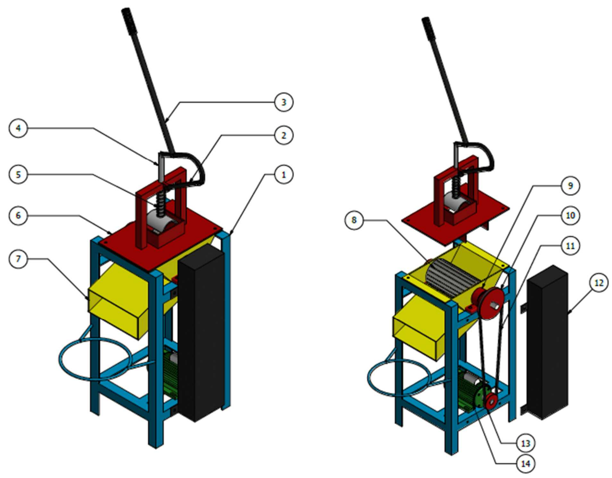

***Figure 2.** Multifunctional Grating tool design.*

Information:
1. Frame.; 2. Pressure lever connector.
3. Pressure lever.; 4. Pressure shaft.
5. Spring.; 6. Frame of pressing system.
7. Grated holes.; 8. Shrunken eyes.
9. Bearings.; 10. Driven pulleys.
11. Belt-v.; 12. Close the drive system.
13. Drive pulleys.; 14. Electric motor.

3.2. Workload

Measurement of physical workload is carried out through the pulse indicator of employees when using old tools and new tools. The employee's work pulse is measured using a pulse meter. The results of measuring employee workload are as follows.

***Table 1.** Workload Calculation Results based on Pulse Rate.*

Variable	Using old tools		Using new tools (multifunctional contractors)		t	P
	Mean (bpm)	SD	Mean (bpm)	SD		
Resting pulse	71.18	3.28	70.84	4.12	5.236	0.172
Work pulse	124.67	4.37	107.12	5.22	3.214	0.001

Description: bpm = beats per minute

Based on Table 1, the results of resting pulse rate calculation using the old tool using the new tool (design results) are not significantly different ($p>0.05$). This suggests that the initial conditions of the workers were the same, so that the initial conditions did not affect the research intervention. While on the working pulse obtained a significant difference ($p < 0.05$), this shows that the use of a multifunctional contracting device design has an influence in terms of workload. The workload before the intervention was 124.67 beats per minute, this included a moderate workload

[3, 6]. While the workload after the intervention (using a multifunctional shaving device design) was obtained 107.12 beats per minute or included a light workload. It can be stated that, there was a decrease in workload from moderate to light or from 124.67 beats per minute to 107.12 beats per minute, a decrease of 14.1%.

3.3. Musculoskeletal Disorders of Research Subjects

Musculoskeletal disorders were measured using the Nordic Body Map questionnaire. Subjects were given questionnaires before work and after work. The results of measuring employee skeletal muscle complaints are as follows.

Table 2. *Results of skeletal muscle complaint analysis.*

Variable	Using old tools		Using new tools (multifunctional contractors)		t	P
	Average	SD	Average	SD		
Musculoskeletal disorders before work	33,18	4,16	33,84	4,12	4,281	0,172
Musculoskeletal disorders after work	72,31	5,39	41,32	3,28	6,724	0,000

Based on Table 2, it was obtained that the value of musculoskeletal disorders before work both when using the old tool (manual method) and using the new tool (using a multifunctional shaving device design), the muscle complaint score was not significantly different ($p = 0.172$ or $p > 0.05$). 'While in skeletal muscle complaints after work there is a significant difference with p value = 0.000 or $p < 0.05$. Judging from the average value, there was a decrease in the musculoskeletal disorders score from 72.31 to 41.32 or a decrease of 42.9%.

These results are in line with research conducted by previous researchers which stated that ergonomic interventions that utilize appropriate technology in the form of work aids can significantly reduce skeletal muscle complaints [14-17].

3.4. Work Fatigue

Data on employee work fatigue was obtained from the results of filling out 30 items of the general fatigue questionnaire. Subjects were given questionnaires before work and after work. Fatigue measurements are carried out when using old tools as well as when using new tools. The fatigue measurement results are as follows.

Table 3. *Results of the analysis of fatigue in general.*

Variable	Using old tools		Using new tools (multifunctional contractors)		t	P
	Average	SD	Average	SD		
Fatigue Before Work	32,27	2,41	33,12	2,79	2,470	0,169
Fatigue after work	82,58	4,38	41,73	4,91	3,592	0,000

The results of measuring work fatigue as stated in Table 3 show that in the initial condition of the workers (fatigue before work) an insignificant difference was obtained with a p value = 0.172 ($p > 0.05$). This shows that the workers have the same initial conditions, both when using old tools and using new tools for multi-functional coconut shredder designs. While in the measurement of skeletal muscle complaints after work, there is a significant difference with p value = 0.000 or $p < 0.05$. Judging from the average fatigue score when using the old tool (conventional method), a fatigue score of 82.58 was obtained, while when using a multifunctional contractor, a score of 41.73 or decreased by 49.5%.

Kroemer and Grandjean state [3] that ergonomic intervention is needed in workers to solve work problems that cause muscle complaints and fatigue, and lead to decreased work productivity. The results of this study are also in line with previous research which states that work fatigue can be significantly reduced with ergonomic interventions in the form of the use of work aids so that workers can work more effectively, safely, and comfortably [18-20].

3.5. Work Productivity

Measurement of productivity of research subjects using the following formula [5]:

$$P = \frac{Op}{I \times t} \tag{1}$$

P is work productivity, Op is output is the number of graters calculated in an hour of work, I is input (average working pulse), and t is time (hours). The results of calculating work productivity using old tools are as follows.

Table 4. *Work productivity of research subjects.*

Variable	Using old tools		Using new tools (multifunctional contractors)		t	P
	Average	SD	Average	SD		
Total Production (kg/hour)	2,49	0,39	11,47	2,18	1,672	0,000
Work productivity	0,02	0,01	0,11	0,01	3,592	0,000

Based on the calculation of production results and work productivity as shown in Table 4, we can see that there is a significant difference in the amount of production and labor productivity ($p < 0.05$). The amount of grated production increased from 2.49 kg per hour to 11.47 kg per hour or an increase of 361.6%. Work productivity increased from 0.02 to

0.11 or an increase of 436.1%.

The increase in production results and work productivity is due to the use of multifunctional contracting tools. Conventional grating work using old tools takes a long time and causes muscle complaints It is mainly on the arms and hands, while grating using a multifunctional shredding tool makes the grating work much faster and more effective. The use of tools in completing work is one of the ergonomic concepts [3, 6]. The tools used by workers must be adjusted to the anthropometric size of workers, so that work can be done comfortably and safely. Increasing productivity in small industries really needs to be done because there are many problems in small industries about not optimal production and work productivity [19, 21, 22].

4. Conclusion

Based on the results of the research and discussion above, the initial conclusions of this study are as follows:

1) The design of multifunctional contractors is carried out according to the anthropometric size of workers. The dimensions of the height of the contractor correspond to the height of the worker's standing elbow, while the press lever matches the worker's hand reach.
2) There was a decrease in workload from using old tools with new tools by 14.1%.
3) There was a decrease in skeletal muscle complaints from the use of old tools with new tools by 42.9%.
4) There was a general decrease in work fatigue from using old tools with new tools by 49.5%.
5) There was an increase in work productivity from the use of old tools with new tools by 436.1%

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