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**Original Article**

# Design of multi station training equipment to improve physical fitness

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**Abstract**
***Problem Statement.*** Physical fitness is an important indicator for a quality life, especially for athletes in maintaining and improving their performance during competitions. This can be achieved with fitness training equipment, but the high cost is an obstacle for some people, so alternatives are needed. ***Purpose***. The purpose of this research is to develop a product in the form of a multi station training tool to improve physical fitness, which consists of exercises for pull ups, static bike, leg extensions and lateral bench press. ***Methods.*** This research is Research and Development (*R&D*) involving 12 experts, namely 4 mechanical engineering experts, 4 measurement test experts, and 4 fitness instructors. Procedures include needs analysis, design and product feasibility testing. The product is designed from various basic materials, namely 10 4" wheels, 5 STAAL pipes measuring 40 x 40 x 6 (2.0), 8 STAAL pipes measuring 60 x 30 x 6 (2.0), 5 pieces of black pipe measuring 1 x 6 (2.0) (31), 5" steel slings, and 1 barbell plate. The feasibility of the designed product was assessed independently by experts according to their expertise, then analyzed using Aiken's V index, Intraclass Correlation Coefficient (ICC) and ANOVA. ***Results.*** The results of the product feasibility analysis show that the average value of the V index was 0.739, and the ICC was 0.854 ($P < 0.05$), with ANOVA was $F = 1.455$; $F = 1.000$; and $F = 2.066$ ($P > 0.05$). ***Conclusions.*** The product in the form of a multi station training tool that has been developed can be used as an alternative to improve physical fitness. Various types of exercises can be done on this tool, such as pull ups, static bike, leg extensions and lateral bench press. Finally, this product is expected to overcome the limitations in obtaining fitness training equipment, both for athletes, non-athletes, trainers and fitness practitioners. Field trials are needed in future research, so that this tool not only meets feasibility indicators, but is also proven effective for improving physical fitness.
**Keywords: multi station training, physical fitness, sports performance**

## Introduction

Currently, the existence of fitness training equipment has made it a successful industry in marketing its products (International Health, Racquet & Sportsclub Association, 2017). It is expected to continue to grow in the global market in facilitating people to gain health and fitness, such as improving cardio-pulmonary function, regulating body fat, strengthening leg muscles, and improving physical abilities (Addolorato et al., 2020). In addition, the help of instructors and trainers plays an important role in optimizing its use (Addolorato et al., 2020).

People are paying more to attain their health and fitness, which will gradually impact national fitness levels (Langhammer & Stanghelle, 2019). This is useful for daily performance and as an indicator of quality life (Welis et al., 2023). This includes athletes' physical fitness, which is an indicator of sports performance and determines the final results of their competitions (Antara et al., 2023; Huang et al., 2019). Sports performance analysis is one of the main sources of information that is useful in the process of training and coaching athletes (Sampaio & Leite, 2013). Basically, coaches and athletes are given information and then they make improvements to the training to improve the performance of their athletes (Hughes & Bartlett, 2015).

In this regard, increased exercise effectiveness can be obtained with fitness equipment, such as exercise machines (Tymoshenko et al., 2021). Its usefulness during sports training is adjusted based on the user's ability to carry out planned and programmed exercises (Mario et al., 2022a; Mario et al., 2022b; Yendrizal et al., 2023),


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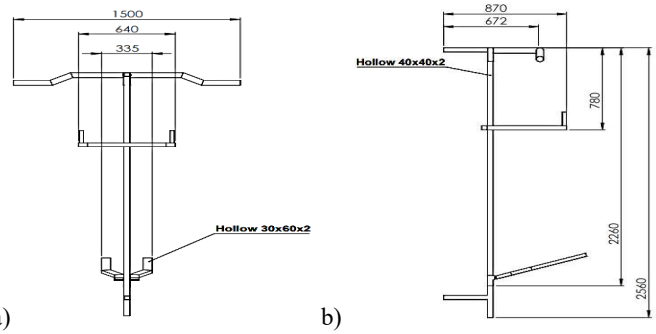
of different genders, ages and levels of physical fitness (Calleja-González et al., 2016; Kozina et al., 2008). Various previous studies have been reported, such as the use of exercise machines to improve speed and coordination (Tymoshenko et al., 2021). This study involved 169 students who played basketball with ages ranging from 17 to 23 years. Reliability of the physical fitness test of the FITescola battery (Henriques-Neto et al., 2020). This study was conducted on 138 young athletes with different sporting backgrounds and competition levels. The test was carried out twice and the testing interval was one week. Extremity equipment for cardiorespiratory fitness (Qian et al., 2018). This study analyzes the feasibility of extremity equipment involving 108 healthy teenagers. Use and perceptions regarding fitness equipment in public parks in communities in small urban centers (Copeland et al., 2017).

Woods et al., basic design of sports evaluation with basic movement testing using Spearman's non-parametric correlation matrix for young Australian athletes (Woods et al., 2018). Tseng et al., investigated a comprehensive physical fitness system for the elderly (Tseng et al., 2013). This study includes four modules to evaluate the health status of the user, where information will be recorded and managed via a wireless network of sensors. Then, development of intelligent execution scheduling systems for fitness and healthcare systems was also investigated by Huang et al., (Huang et al., 2015). To our knowledge, studies investigating and developing multi-station training tools to improve physical fitness are still very rare.

Therefore, the aim of this research is to develop a product in the form of a multi station training tool to improve physical fitness. This product is expected to overcome limitations in obtaining fitness training equipment, both for athletes, non-athletes, trainers and fitness practitioners.

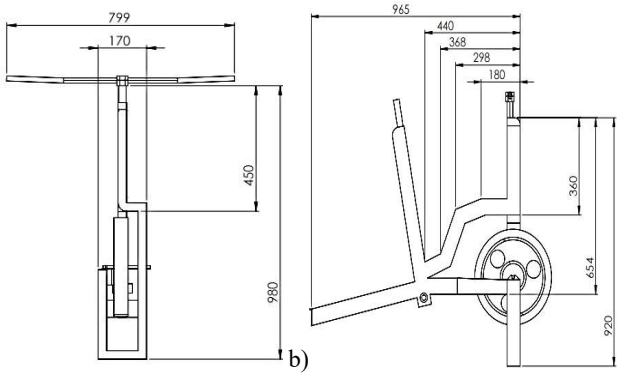
**Materials & Methods**

This research is *R&D*, which aims to develop a product in the form of a multi station training tool. A total of 12 experts were involved voluntarily to assess its feasibility, each of whom were 4 mechanical engineering experts, 4 measurement test experts, and 4 fitness instructors. Procedures include needs analysis, design and product feasibility testing. The needs analysis is based on limited costs to obtain fitness equipment. The product design stage consists of various basic materials, namely 10 4" wheels, 5 STAAL pipes measuring 40 x 40 x 6 (2.0), 8 STAAL pipes measuring 60 x 30 x 6 (2.0), 5 pieces of black pipe measuring 1 x 6 (2.0) (31), 5" steel slings, and 1 barbell plate. The multi station training equipment designed will focus on exercises for pull-ups (Figure 1), static bike (Figure 2), leg extensions (Figure 3), and lateral bench press (Figure 4). After this product was designed, experts provided independent assessments to assess the suitability of the product, until there was an agreement to produce a product in the form of a multi-station training tool.



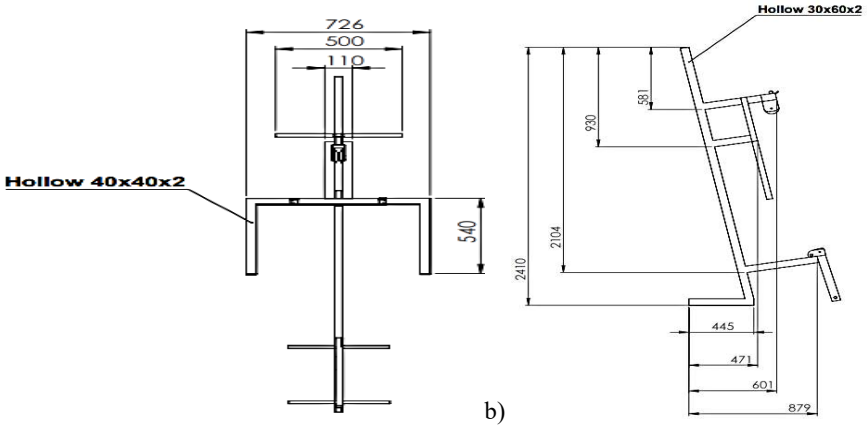

a) b)

Figure 1. Sketch of multi station training tool for pull up exercises, a) front view, and b) side view



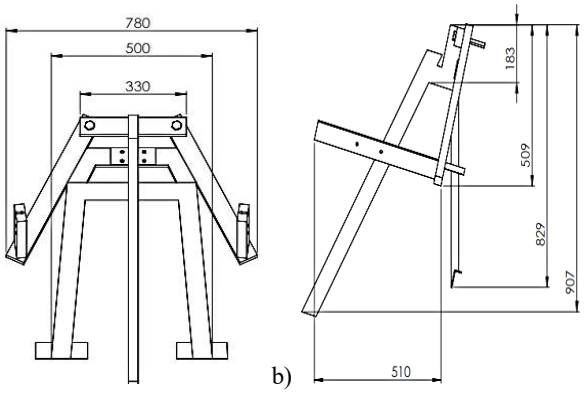

a) b)

Figure 2. Sketch of multi station training tool for static bike, a) front view and b) side view




a) b)

Figure 3. Sketch of multi station training tool for leg extension exercises, a) front view, and b) side view




a) b)

Figure 4. Sketch of multi station training tool for lateral bench press exercises, a) front view and b) side view

Then, product feasibility assessments were analyzed using Aiken's V index, ICC and ANOVA. The classification of V index values is $V > 0.8$ for the high category, $0.4 \leq V \leq 0.8$ for the sufficient category, and $V < 0.4$ for the low category. Meanwhile, the ICC values are $ICC > 0.80$ for the very high category, 0.61-0.80 for the high category, 0.41-0.60 for the moderate category, and $ICC < 0.41$ for the low category. Data were analyzed using IBM SPSS version 23 statistical software.

$$V = \frac{\sum s}{n(c-1)} \qquad ICC = \frac{\sigma_s^2}{\sigma_s^2 + \sigma_b^2 + \sigma_\varepsilon^2}$$

**Results**

*Product description*

The final form of the product in the form of a multi station training tool is presented in Figure 5. This multi station training tool can be used for various exercises to improve physical fitness, such as pull ups, static bike, leg extensions and lateral bench press (Figure 6.a). Meanwhile, the shape of the multi station training tool from the side and top is presented in Figures 6.b and 6.c.

Pull up exercises can be done on this tool to train upper body muscle strength. In addition, various variations of pull up movements can also be done to obtain optimal muscle strength, such as reguler pull up, chin up, one hand pull-up, side to side pull up, wide grip pull up, close grip pull up, hanging leg raise pull up, hanging knee pull up, weighted pull up, and behind the neck pull up.

Static bike can be done with this tool to burn fat and do cardio exercise. Other benefits include lowering blood pressure and cholesterol levels, helping control body weight, strengthening heart performance, improving fitness and training leg muscles. Leg extension exercises to shape the front thigh muscles, especially the thigh muscles that are located above the knee, can also be done with this tool. This exercise is done by sitting on a leg extension device and adjusting the load according to your ability, keep your back straight with the support behind you, swing your legs forward and lower them slowly, repeat this exercise according to the specified repetitions and sets. Then, the bench press exercise, which is one of the weight training exercises, is also presented to increase muscle strength in the arms, shoulders and chest.

Figure 5. Final shape of the multi station training tool

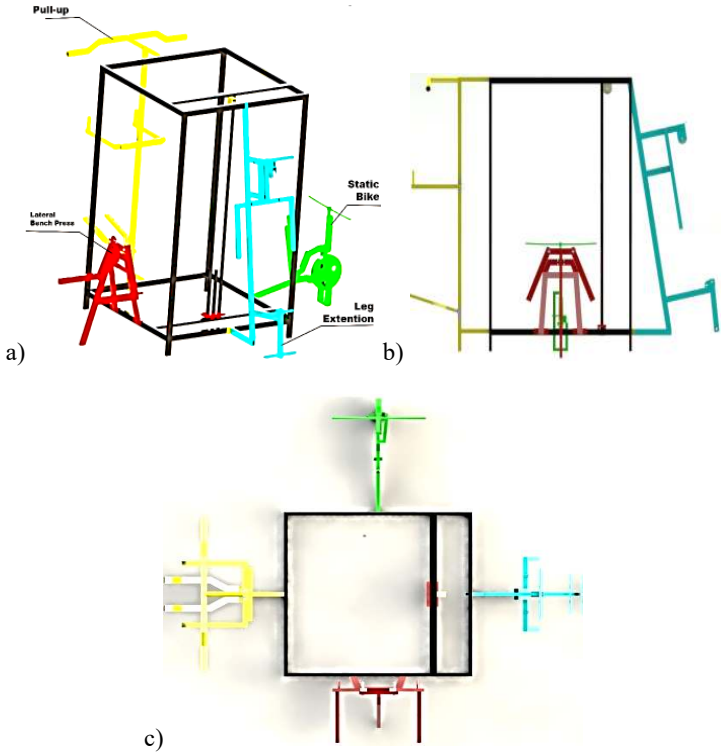



Figure 6. a) Multi station training and types of training, b) side view, c) top view

*Product feasibility*

The average product feasibility analysis results were obtained 0.739 ± 0.113, mechanical engineering (0.733 ± 0.109), measurement test (0.717 ± 0.112), and fitness instructor (0.767 ± 0.137) (see Table 1 and Figure 7). Then, table ANOVA ($F$ = 1.455; $F$ = 1.000; and $F$ = 2.066; $P > 0.05$), with an average ICC value of 0.854 or $P < 0.05$ (see Tables 2 and 3).

Table 1. Summary of V index values

| Source | *r.1* | *r.2* | *r.3* | *r.4* | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $\sum s$ | *n(c-1)* | *V* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mechanical engineering (*n*=4) | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |
| | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |
| | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |
| | 3 | 3 | 3 | 4 | 2 | 2 | 2 | 3 | 9 | 12 | 0.750 |
| | 3 | 4 | 4 | 4 | 2 | 3 | 3 | 3 | 11 | 12 | 0.917 |
| Total | 15 | 16 | 16 | 17 | 10 | 11 | 11 | 12 | 44 | 60 | 0.733 ± 0.109[a] |
| Measurement test (*n*=4) | 4 | 4 | 3 | 4 | 3 | 3 | 2 | 3 | 11 | 12 | 0.917 |
| | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |
| | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |
| | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |
| | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |
| Total | 16 | 16 | 15 | 16 | 11 | 11 | 10 | 11 | 43 | 60 | 0.717 ± 0.112[a] |
| Fitness instructor | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (*n*=4) | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |
| | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 8 | 12 | 0.667 |
| | 3 | 4 | 4 | 4 | 2 | 3 | 3 | 3 | 11 | 12 | 0.917 |
| | 3 | 4 | 4 | 4 | 2 | 3 | 3 | 3 | 11 | 12 | 0.917 |
| Total | 15 | 17 | 17 | 17 | 10 | 12 | 12 | 12 | 46 | 60 | 0.767 ± 0.137[a] |
| Total | 46 | 49 | 48 | 50 | 31 | 34 | 33 | 35 | 133 | | 0.739 ± 0.113[b] |

*r* is rater.

a. Mean and standard deviation from each expert.

b. Mean and standard deviation of all experts.

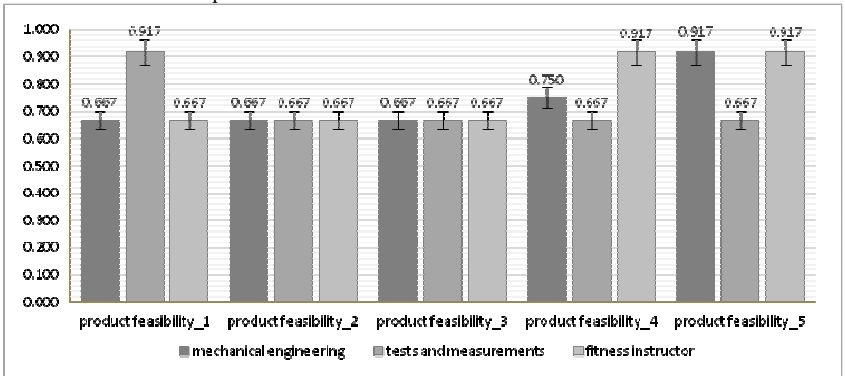



Figure 7. V index value from each rater

Table 2. Summary of ANOVA

| Source[*] | | *SS* | *df* | *MS* | *F* | *P* |
|---|---|---|---|---|---|---|
| | *BP* | 1.700 | 4 | 0.425 | | |
| *WP* | *BI* | 0.400 | 3 | 0.133 | 1.455 | 0.276 |
| | Residual | 1.100 | 12 | 0.092 | | |
| | Total | 1.500 | 15 | 0.100 | | |
| Total | | 3.200 | 19 | 0.168 | | |
| Source[**] | | *SS* | *df* | *MS* | *F* | *P* |
| | *BP* | 1.800 | 4 | 0.450 | | |
| *WP* | *BI* | 0.150 | 3 | 0.050 | 1.000 | 0.426 |
| | Residual | 0.600 | 12 | 0.050 | | |
| | Total | 0.750 | 15 | 0.050 | | |
| Total | | 2.550 | 19 | 0.134 | | |
| Source[***] | | *SS* | *df* | *MS* | *F* | *P* |
| | *BP* | 2.700 | 4 | 0.675 | | |
| *WP* | *BI* | 0.600 | 3 | 0.200 | 2.0667 | 0.095 |
| | Residual | 0.900 | 12 | 0.075 | | |
| | Total | 1.500 | 15 | 0.100 | | |
| Total | | 4.200 | 19 | 0.221 | | |

There was no difference in assessment ($P > 0.05$); BP is Between People; WP is Within People; BI is Between items; SS is Sum of Squares; MS is Mean Square.

[*]Mechanical engineering; [**]tests and measurements; [***]fitness instructor.

Table 3. Summary of Intraclass correlation coefficient

| Source | *ICC*[b] | Confidence Interval (95%) | | *F* | | | |
|---|---|---|---|---|---|---|---|
| | | *LB* | *UB* | Value | *df1* | *df2* | *P* |
| *SM*[*] | 0.476[a] | 0.030 | 0.908 | 4.636 | 4 | 12 | 0.017 |
| *AM* | 0.784[c] | 0.111 | 0.975 | 4.636 | 4 | 12 | 0.017 |
| *SM*[**] | 0.667[a] | 0.228 | 0.951 | 9.000 | 4 | 12 | 0.001 |
| *AM* | 0.889[c] | 0.542 | 0.987 | 9.000 | 4 | 12 | 0.001 |
| *SM*[***] | 0.667[a] | 0.228 | 0.951 | 9.000 | 4 | 12 | 0.001 |
| *AM* | 0.889[c] | 0.542 | 0.987 | 9.000 | 4 | 12 | 0.001 |
| *M* ± *SD* (0.854 ± 0.061) | | | | | | | |

Significant ($P < 0.05$); SM is Single Measures; AM is Average Measures; ICC is the Intraclass Correlation value; LB is Lower Bound; UB is Upper Bound.

[*]Mechanical engineering; [**]tests and measurements; [***]fitness instructor.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type *C* intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

**Discussion**

From the feasibility analysis, the product in the form of a multi station training tool can be used as an alternative to improve physical fitness. Various types of exercises are presented on this tool, such as exercises for pull ups, static bike, leg extensions and lateral bench press. Indicators of product suitability obtained an average value of the V index was 0.739, and ICC was 0.854 ($P < 0.05$), with ANOVA was $F = 1.455$; $F = 1.000$; and $F = 2.066$ ($P > 0.05$). Validity and reliability are important or prerequisites for determining the quality and accuracy of measurement tools (Kimberlin & Winterstein, 2008; Mohajan, 2017). Previous studies reported that a measuring instrument can be considered effective if it has good validity and reliability values (Bajpai & Bajpai, 2014). The product design being developed cannot be separated from various equipment, varying costs and expertise (Palmer et al., 2023).

The results of the feasibility of the product in the form of a multi station training tool highlight the need to assess the relevance of the content based on the objectives of product development. Previous studies reported that content validity involves the assistance of experts according to their expertise to assess the suitability of the product and ensure the relevance of the product being developed (Almanasreh et al., 2019). Meanwhile, inter-rater reliability refers to the extent of error in giving different assessments to the product being developed (Solikhin et al., 2023).

Content validity provides evidence about the extent to which elements of an assessment instrument are relevant and representative of the constructs targeted for assessment purposes. Assessment of content validity relies on the use of a panel of experts to evaluate instrument elements and rate them based on their relevance and representativeness in the content domain (Almanasreh et al., 2019). In addition, the content validity index is an important factor in the instrument development process, so it must be carried out and reported, because it is as important as other types of construct validation (Almanasreh et al., 2019). This is consistent with previous studies, content validity should receive the highest priority during the development process, as it is a prerequisite for evaluating other types of validity. This section provides practical guidelines for evaluating content validity (Almanasreh et al., 2019). Then, ICC is a reliability index that is often used for test-retest, intrarater and inter-rater reliability analysis (Koo & Li, 2016). Therefore, it is important for researchers to know the correct application of each, use the appropriate form in their analysis, and report accurately according to the form they use (Koo & Li, 2016).

This product, which is a multi-station training tool, has been tested through content validity, where assessors independently evaluate the relevance of the content according to the suitability of the product (Wynd et al., 2003). Level inter-rater reliability based on ICC values also showed no differences (Robertson et al., 2013). These results were discussed with experts to evaluate the product's shortcomings until an agreement was reached to present a product in the form of a multi-station training tool to improve physical fitness, which consists of exercises for pull ups, static bikes, leg extensions and lateral bench press.

This research is an initial stage of research funded by the Institute for Research and Community Service (LPPM, Universitas Negeri Padang), so this initial stage only reaches product feasibility testing. The following year's research was a field trial to prove the effectiveness of the multi station training tool, so that this tool not only met the feasibility indicators, but was also proven to be effective in improving physical fitness.

**Conclusions**

A product in the form of a multi station training tool has been successfully developed, which meets the feasibility indicators with an average V index value of 0.739, and ICC was 0.854 ($P < 0.05$), with ANOVA being $F = 1.455$; $F = 1.000$; and $F = 2.066$ ($P > 0.05$). This tool consists of various types of exercises such as pull ups, static bike, leg extensions, and lateral bench press. Pull ups and various variations can be done to train upper body muscle strength. Static bikes are focused on burning fat and cardio training. Leg extension exercises to shape the front thigh muscles, especially the thigh muscles that are located above the knee, can also be done with this tool. Then, bench press exercises can be done to increase muscle strength in the arms, shoulders and chest. Finally, the product in the form of a multi station training tool that has been developed can be used as an alternative to improve physical fitness, both for athletes, non-athletes, trainers and fitness practitioners. This research is in the initial stage, and the following year's research will be the implementation of the use of this product. Then, the design and addition of training forms on multi-station equipment is also needed for future research.

**Conflicts of interest-** The authors report that there is no potential conflict of interest.

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