



Development of Flexibility Training Equipment Middle Split in Taekwondo

Moh. Gufron Katili^{1✉}, Cahyo Yuwono²

¹ Universitas Negeri Semarang, Indonesia; mgkatili07@students.unnes.ac.id

² Universitas Negeri Semarang, Indonesia; cahyoyuwono@mail.unnes.ac.id

Article Info

History Articles

Received:

January 2026

Accepted:

January 2026

Published:

September 2026

Keywords:

*Training Aid, Split,
Flexibility, Taekwondo*

Abstract

This study aims to develop a safe, measurable, and innovative training aid for middle split flexibility in taekwondo. The development of this tool is based on relevant previous research, which has been modified to incorporate an innovative feature: an automatic degree reader integrated into each rotation of the steering wheel. This feature allows coaches and athletes to monitor improvements in middle split flexibility objectively and in real time. The background for the development of this tool is based on a phenomenon that often occurs in taekwondo training clubs, namely the use of conventional split training methods that are coercive and have the potential to cause serious and prolonged injuries. This aligns with the findings of Ross et al. (2025), who stated that inappropriate flexibility training approaches can increase the risk of injury in athletes. Thus, the developed tool is expected to serve as an alternative solution for safer, more controlled, and effective mid-split flexibility training, supporting the optimization of taekwondo athletes' performance.

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✉ Address correspondence:
Universitas Negeri Semarang, Kampus Sekaran, Gunungpati,
Semarang
E-mail: mgkatili07@students.unnes.ac.id

p-ISSN 2252-648X
e-ISSN 2502-4477

INTRODUCTION

Taekwondo is a martial art originating in South Korea that emphasizes high kicking techniques and body flexibility. To achieve optimal flexibility, split training is often an integral part of taekwondo athletes' training programs. However, forcing split training without considering individual physical conditions can increase the risk of injury, especially to the thigh muscles and joints and other lower body parts.

Common injuries resulting from forced split training include muscle strains, ligament tears, and injuries to the hip and knee joints. Studies by (Covarrubias et al., 2019) shows that excessive training and chronic fatigue are the main causes of injury in taekwondo athletes, with the ankle and pelvis being the most commonly reported injury sites.

Forced split training without adequate preparation can cause injuries such as muscle strain, ligament tears, and damage to other soft tissues (Herstiani & Anam, 2024). Problems that often arise when doing splits include pain in the back of the thighs, hip joints, and waist, as well as possible hamstring and groin injuries.(Chandra, 2017).

Shows that the wrong approach to exercise can increase the likelihood of injury (Ross et al., 2025). The same as according to (Ingham et al., 2017) believes that musculoskeletal injuries can occur in both professional and amateur individuals. This depends on factors related to the mechanism, intensity, and type of injury. Research by (Pristianto et al., 2022) "The correlation test results show that there is a direct correlation between an increase in musculoskeletal injuries and an increase in exercise. This is due to many factors, particularly related to an understanding of exercise patterns and procedures that are not appropriate.

A lack of understanding of exercise, guidance from exercise experts, tools/equipment, and exercise procedures (including warm-ups) leads to high injury

rates. Following up on previous research related to injuries caused by various factors, including flexibility exercises that are not performed with the correct technique, procedures, training aids, and without supervision, can lead to the risk of serious injury.

This phenomenon is similar to what the author observed at one of the clubs/dojangs in Gorontalo City, namely the Egale Taekwondo Club branch of SMP Islam Terpadu Kabila, which is a branch of the parent club ETC Gorontalo City. Based on observations at the training site, the training sessions still use conventional methods, pairing up with a partner and leaning against a wall, then being suddenly pushed (forced) or, in other words, performing with excessive weight and without any training aids, resulting in a very high risk of injury due to these forced training methods. This is based on the initial observation results conducted on May 8, 2025. As shown in the image below:



This forced training method has an impact on the athletes themselves, where every week of the split training program, many athletes are reluctant to attend the training sessions because they do not want to experience pain from forced training, which can lead to serious injuries.

The tool to be developed aims to serve as a medium to assist training sessions and

support split capabilities to be more practical and comfortable. With references and descriptions from previous studies that have advantages and disadvantages, and several large and immovable tools in the gym, then in several online stores, they are priced quite high, so that it can be one of the influences of the low use of tools to support training.

Therefore, the idea of developing this tool is expected to be a more practical and affordable solution for coaches and athletes to use in split training sessions with a portable, flexible, strong, and easy-to-use tool concept. This led to the concept titled “Development of a Central Split Flexibility Training Tool in Taekwondo” for further research.

The novelty in this research adopts several previous studies, namely research from:

1. Development of a 2-in-1 Leg Split Machine Prototype. Filli Azandi, Mawardinur, Ade Ros Riza, Fany Rahmasari (2021).
2. Development of a Flexonarita Tool Model for Split Movement Flexibility Training in Taekwondo Sinta Narita Devi (2020).
3. Development of Arduino-Based Split Test Measurement Technology and Infrared Sensor with LED Display Imam Safei (2018).

METHODS

The type of research design used in this study is R&D (Research & Development), which is research into the development and creation of a product. In this study, the product developed is a model device for split flexibility training in the sport of Taekwondo. This study focuses on developing a tool to train Taekwondo practitioners in side/middle split flexibility so that they can perform kicks to their full potential without risking injury. The tool is intended for Taekwondo coaches, Taekwondo athletes, the general public, and other sports that require split flexibility

training. The data used in this study was collected through questionnaires filled out by subject matter experts, practitioners, and taekwondo athletes as test subjects. A total of 53 athletes participated as respondents.

The procedures in this study followed the model Sugiyono (2019), which includes several stages, namely: potential and problems, data collection, product design, design validation, design revision, small-scale testing, product revision, and large-scale testing. These stages are carried out systematically to ensure that the resulting product is feasible, practical, and effective for use in split taekwondo training sessions.

RESULTS AND DISCUSSION

Based on the results of validation tests and revisions by experts related to the developed tools and assessment instruments, the tool usage test was conducted in two stages, namely small-scale trials stages I and II and a large-scale trial.

Small-scale trials stages I and II were conducted at the Egale Taekwondo club, involving 23 athletes. In the small-scale trial phase 1, the developed tool received a “very good” rating with an overall average score of 85%. The results of the questionnaire completed by athletes in the small-scale trial phase 1 on the developed product covered four main aspects, namely originality, functionality, superiority, and comfort and safety. The originality aspect received a percentage of 85% with a very good category. The functionality aspect received a percentage of 84% with a very good category. The superiority aspect received a percentage of 84% with a very good category. The comfort and safety aspect received a percentage of 86% with a very good category, indicating that the product functions well when used in the training process.

The following are the results of the athlete questionnaire in the first phase of the small-scale trial:

No	Aspect	Percentage
1	Originality	85%
2	Functionality	84%
3	Superiority	84%
4	Comfort & Safety	86%
Average		85%

Table 1. Results of the Small-Scale Trial Athlete Questionnaire Phase I

The results of the second phase of small-scale trials show that the originality aspect scored 89% in the excellent category, the functionality aspect scored 91% in the excellent category, the superiority aspect scored 87% in the excellent category, and the comfort and safety aspect scored 93% in the excellent category. The average of these four aspects is 90%, which is in the excellent category.

The following are the results of the athlete questionnaire in the second stage of the small-scale trial:

No	Aspect	Percentage
1	Originality	89%
2	Functionality	91%
3	Superiority	87%
4	Comfort & Safety	93%
Average		90%

Table 2. Results of the Small-Scale Trial Athlete Questionnaire Phase II

These results show that the development of the Central Split Training Aid is deemed acceptable and usable by coaches and athletes with excellent ratings, without any weaknesses found in previous product improvements, so that it can be used as a medium or option for use in split training sessions. All data from this small-scale trial will be used as a reference in

improving product quality before a large-scale trial is conducted. Any obstacles and challenges that arise during the trial process will be identified and resolved, given that this step is crucial to ensuring the successful development of the Split Center Training Aid.

The questionnaire results provide a clear picture of the suitability of the Split Middle Training Aid, with all four aspects receiving positive and consistent ratings. These results indicate that the developed product meets the basic needs of users, although further refinement is still needed in subsequent stages.

Based on the accumulated results from small-scale trials in stages 1 and 2, the following percentages were obtained:

N O	Aspect	SMALL- SCALE TRIAL		TOTAL SCORE	MAXIMUM SCORE	PERCENTAGE
		STAGE 1	STAGE 2			
1	Originality	491	514	1005	1150	87%
2	Functionality	485	522	1007	1150	88%
3	Superiority	484	502	986	1150	86%
4	Comfort & safety	494	532	1026	1150	89%
Average Percentage						87%

Table 3. Results of Small-Scale Trials in Stages 1 and 2

Here are the results of the large-scale trial presentation:

N O	ASPECT	TOTAL SCORE	MAXIMUM SCORE	PERCENTAGE
1	Originality	721	750	96%
2	Functionality	713	750	95%
3	Superiority	702	750	94%
4	Comfort & safety	727	750	97%
Average Percentage				95%

Table 4. Results of the Large-Scale Trial
Athlete Questionnaire

Based on the results of large-scale trials conducted at Dojang Eagle Taekwondo Man 1 and Eagle Taekwondo Club Kabila, Bone Bolango, involving 30 athletes, the data shows the percentage in four aspects, namely originality, functionality, superiority, and safety and comfort. In terms of originality, the product achieved a score of 96%, which is categorized as “Very Good.” This result reflects that the product is considered original, with the concept, design, and features incorporated into the equipment components based on prior research.

In terms of functionality, the product achieved a rating of 96%, which falls into the Excellent category. This achievement shows that every component in the device is able to work optimally, stably, and in accordance with its intended use. During the testing process, the device proved capable of supporting all stages of the mid-split training session without experiencing any significant disruptions. With such consistent performance, the product is considered capable of providing an effective user experience and supporting the training session process.

In terms of excellence, the product received a rating of 94%, which falls into the “Very Good” category. This result shows that each component of the device has advantages that can facilitate split training sessions, whether used independently or under the supervision of a trainer. The degree display feature, which works based on the movement of the sensor opening, allows athletes and coaches to monitor and review the level of mid-split flexibility more accurately. The information displayed provides a direct overview of the athlete's progress, enabling a more effective evaluation and adjustment of training.

The comfort and safety aspects received a score of 97%, which falls into the Excellent category. These results show that the Mid-Split Exercise Aid is designed with

ease of use and safety during exercise sessions in mind. This is reflected in the respondents' assessments, who stated that this device provides comfort and safety when used continuously. From a safety perspective, the materials used are also considered to pose no risk of injury or danger to athletes, allowing the equipment to be operated safely during every training session. Thus, the design and choice of materials for this equipment successfully support safe and comfortable training needs.

Overall, the average assessment percentage of the four aspects reached 94%, which falls into the “Very Good” category, indicating that Multi NetRing media has a very positive influence and receives a good response from students. These results confirm that Multi NetRing is not only effective in supporting learning, but also able to attract interest and is enthusiastically accepted by users. The following is the large-scale trial data.

CONCLUSION

The results of the development of the Central Split Training Aid product show that this product is capable of having a positive impact on the split training session process. Based on validation tests, this product development has been deemed suitable for use and has received an excellent rating. This is in line with the findings from the trial phase, both small and large scale, which placed the Central Split Training Aid in the high percentage range. However, more important than these figures is the real impact that has been seen in the field.

When this development product was applied in the training process, it was clearly evident that the split training sessions conducted by coaches and athletes became more varied and conducive. The athletes showed increased enthusiasm and active participation in split training. This was in contrast to training sessions before the introduction of the Central Split Training

Aid, where athletes tended to be less motivated and reluctant to participate in split training sessions. In the conventional method, split training was generally carried out using a coercive approach that required athletes to immediately achieve certain positions without adequate support from equipment.

This approach often causes discomfort and even fear of injury, causing athletes to feel stressed and less enthusiastic about training. Conversely, with the Split Center Training Aid, the training process can be carried out gradually, safely, and in a controlled manner. This not only reduces athletes' fears, but also boosts their confidence and provides new options for split training sessions.

In this section, the researcher emphasizes that this is not intended to imply that conventional training methods are ineffective or incorrect. Conventional methods still have their own value and benefits in the training process. However, through the development of training aids designed by the researcher, it is hoped that these can become an alternative or new option in the implementation of split training sessions. The presence of this training aid tool aims to complement existing conventional methods, so that coaches have more variety in their approach to training athletes. With this new option, the training process is expected to be safer, more effective, and more interesting, as well as able to adapt to the needs and conditions of each athlete.

The high scores obtained at each stage of the trial further reinforce the research findings that this product development has a tangible positive impact. The increased enthusiasm and active involvement of athletes during training sessions show that the Central Split Training Aid can significantly improve the quality of the training process. This positive response serves as an indicator of the product's development success, both in terms of

functionality, comfort, and effectiveness of use. Therefore, the Split Center Training Aid is deemed suitable and recommended for widespread use as an alternative support tool in split training sessions.

ACKNOWLEDGEMENT

The author would like to express sincere gratitude to all individuals who contributed to the completion of this work but are not listed as authors. Special thanks are extended to the teachers and staff of special education schools who provided valuable assistance during data collection and insight into the daily learning environment of children with mild intellectual disabilities. Thanks are also extended to parents and caregivers who willingly shared their experiences and supported the research process. The author acknowledges the constructive input from academic advisors and colleagues who reviewed early drafts of this manuscript and provided useful feedback for improvement. We also thank the institutional librarians who assisted in accessing national and international journal databases during the literature search.

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