



Dwi Chagi Kick Reaction Speed Training Model based on Electronic Body Reaction in Taekwondo Athletes Aged 14-16 Years

Abdul Ghoni^{1*}, Moch Asmawi², Fahmy Fachrezzy³, Evi Susianti⁴, Gatot Jariono⁵

^{1,2,3}Physical Education, Postgraduate, Universitas Negeri Jakarta, Jakarta, Indonesia

⁴Physical Education Health and Recreation, Universitas Singaperbangsa Karawang, Karawang, Indonesia

⁵Physical Education, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

Article Info

Article History :

Received : August 2024

Revised : September 2024

Accepted : September 2024

Keywords:

Dwi Chagi,
Electronic Body Reaction,
Reaction Speed

Abstract

This study aims to help solve the weaknesses in kicking skill training Dwi Chagi. It can also provide theoretical benefits in kicking exercises Dwi Chagi and practical benefits for researchers, institutions, coaches, athletes, and general readers. Researchers in this paper are working on model development, trying to create and innovate on the design of reaction rate-based training models for electronic body reactions, existing or new, to solve a problem. As with kick training Dwi Chagi, research and development (Research & Development) will produce a reaction speed-based training model product electronic body reaction on kicking skill training Dwi Chagi for taekwondo athletes aged 14-16 years. This research is intended to produce a new and valuable addition to the advancement of science in Taekwondo, especially in exercise, biomechanics, and physiology. This study uses the ADDIE method; in ADDIE, research has five stages: analysis, design, model development, implementation, and evaluation. The research results produced a product in the form of a kick reaction speed training model, a Dwi Chagi-based electronic body reaction. For 14-16 years of taekwondo athletes, it was carried out with 30 male and female athletes. Data was collected through documentation, interviews, and observation activities. Data analysis was carried out descriptively. The research results are in the form of a model book for kick reaction speed training Dwi Chagi-based electronic body reaction. The study's results prove that the training model is quite effective in applying and developing kicking techniques Dwi Chagi.



*Corresponding email : tesis.aghon2@gmail.com

ISSN 2685-6514 (Online)

ISSN 2477-331X (Print)

INTRODUCTION

Taekwondo is one of the sports registered in DBON (National Sports Grand Design) made by the Ministry of Youth and Sports. Taekwondo's Olympic achievements are part of the PBTI initiative. The Executive Board of Indonesia Taekwondo (PBTI) has sent several athletes to the Asian World Taekwondo qualification tournament. Since the WTF (World Taekwondo Federation), Taekwondo was approved to participate in the 2000 Sydney Olympics; at that time, it has been the subject of extensive research, where one of the areas of interest is identifying success factors. The effectiveness of training in sports is measured by the best performance (results) in the most important competitions, (Bozkurt, 2023) stated that most of the research aims to find correlations between various indicators and taekwondo performance, including morphological, biomechanical, conditioning, physiological, and psychological indicators, and coordination indicators. Psychologists, coaches, and athletes have widely used mental training techniques to improve learning and performance in sports. This mental aspect has various cognitive and psychological abilities that an athlete must have.

Taekwondo is a martial art that focuses on hand and foot movements (Kim, 2021). "Tae" refers to kicking or smashing with the foot, "Kwon" to hit or smash with the hand, and "do" to the concept of martial arts or philosophy; the three words make up the name "Tae kwon do." In taekwondo competitions, there are two categories of numbers, namely Kyourigi (fighting) and Poomsae (moves); taekwondo competition rules use the latest Competition Rules following the format of The Best of Three (Podrigalo et al., 2023). (Yao Y, 2023) also, "Successful competitors (medallists) demonstrated

significantly better technique, conditioning, and flexibility parameters. Technical skills (e.g., strikes and side and roundhouse kicks), speed, dynamic strength, and endurance were the factors that contributed to the achievement of excellent results in taekwondo" (Yao, 2023).

In Taekwondo, technological developments have changed the match system where Taekwondo matches use a protector scoring system. PSS (Protector Scoring System) is a tool equipped with sensors used in Taekwondo championships to assess scores in a match (Jia et al., 2024). This aims to make the assessment more accurate and objective. In addition, it helps minimize injuries by prioritizing technique, tactics, mentality, and fair play (Moenig et al., 2023). Thinking intelligence is critical to defeating opponents who stand and move dynamically. The increase in response time is highly emphasized because the quick and precise attacks of the opponent become a significant obstacle. Strength, agility, balance, coordination, and accuracy are further skills developed through practice and are essential for maintaining one's balance and efficiently defending oneself from various attacks of the opponent. According Brade stated that "intense training in Taekwondo has a significant impact on multiple aspects of athletes' physical activity (Bridge et al., 2014).

The technique that is the main focus of this study is the dwi chagi kick technique (Hariadi et al., 2023). A good kick has speed and has the power to balance the kick reached to the target. The dwi chagi kick in a kyourigi match is a high-scoring technique that spins a kick towards the opponent's stomach or head, with a proleariat of four abdominal points and five points for the head, perfection of technique, accuracy, speed, and strength. The dwi chagi skill determines the

acquisition of points because points will only get 4 or 5 points if the form of technical skills is perfect. The problems that generally affect the results of dwi chagi kick skills are several factors, namely: 1) Timing when doing dwi chagi kick and 2) Dwi Chagi's kicking skills that have yet to be mastered well. 3) Kicking ability in each position. 4) mental state when doing dwi chagi kicks, especially in certain situations. 5) training stages that have not been innovative are adjusted to the growth of athlete development.

The advancement of digital technology must be able to collaborate with the training process; in essence, the training goals are still the same, but new ways are needed so that the training process is close to the perfection of the best results. In this study, the researcher focused on the development of an electronic body reaction-based reaction speed training model for dwi chagi kicking skills where the proper training stages will be made for athletes aged 14-16 years, and it is hoped that the results of this research are efficient, effective and can continue to be developed.

Researchers in this paper are working on model development, trying to create and innovate in the design of existing or new electronic body reaction-based reaction speed training models to solve a problem. As with the dwi chagi kick exercise, research and development (Research & Development) will produce a reaction speed training model based on electronic body reaction in the dwi chagi kick skill training for taekwondo athletes aged 14-16 years. This research is intended to produce a new and valuable addition to the advancement of science in Taekwondo, especially in exercise, biomechanics, and physiology.

Research involves scientific activities based on the study of relevant theories that aim to improve problems. The function of research involves finding

explanations and solutions to a problem. Research is divided into several types: quantitative research, which is divided into comparative and associative; program or policy evaluation research; development research, both model and instrument development; action research; and qualitative research. The following is an explanation of the types of research: a) Quantitative research can be categorized into two types: 1) Comparative research. Comparative studies compare two or more groups in a given variable (Creswell, 2015). 2) Associative research, examining the relationship or influence of several variables (Fraenkel & Wallen, 1993). b) Program or Policy Evaluation Program evaluation studies assess the effectiveness, quality, and value of a particular program or policy (Shinkfield & Stufflebeam, 2007). c) Research and development is creating new products or improving existing products to be more effective and relevant. This research consists of a methodological approach to designing, developing, and evaluating programs, processes, and learning outcomes that must meet internal standards of consistency and effectiveness (Syaifullah & Doewes, 2020) (Borg & Gall, 1989). d) Action Research is a research approach that allows researchers to test and improve theories in practical contexts and acquire knowledge about effective and efficient actions (Mills, 2000). e) Qualitative research is a research approach that aims to acquire comprehensive knowledge about the topic being researched by subjectively interpreting and analyzing the data obtained (Creswell, J. W., & Poth, C. N. 2016).

ADDIE is a development model that includes six methods steps, allowing researchers to create legitimate, sound, practical products. The ADDIE model consists of five stages of multimedia development: analysis, design, development, implementation, and

evaluation. ADDIE appeared in the 1990s and was created by Dick and Carey. One of ADDIE's roles is to provide instructions while building tools and equipment—an adequate, dynamic, and valuable training program infrastructure. The development stages of the ADDIE model are intertwined with each other. The use of this model should be completed gradually and thoroughly. In line with Pribadi, B. A. (2014: 23), referred to in Putri, L.O (2020: 19) The levels of the ADDIE model are:

1. Analysis: At this stage, an educational needs evaluation process known as school needs evaluation or TNA (Training Needs Analysis) must be carried out. The design of learning programs needs to collect data and information related to overall performance issues.
2. Design: This stage is completed by identifying the sub-competencies that the member wants to master to master the overall capabilities of the learning software.
3. Development: The development stage consists of an agenda for creating, providing, and organizing media to achieve the goal of mastery so that it can be decided.
4. Implementation: At this stage, the educational program is carried out according to the layout developed previously.
5. Evaluation: Evaluation can be interpreted as determining an object's value, tariff, and profit in research as a product or to gain software knowledge. Assessments can be classified into formative and summative assessments based on the causes of their use.

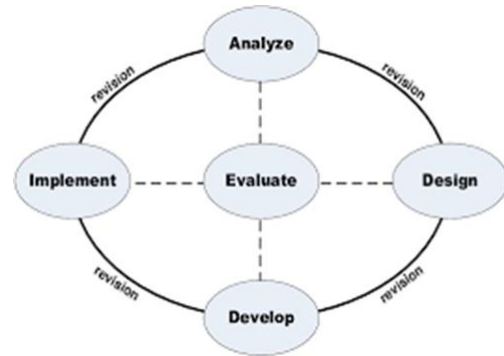


Figure 1. ADDIE Model Research and Development Design

The exercise development model has comparable actions and strives to meet the exercise's goals. However, each model has advantages and limitations and varying requirements for preparing the initial product. The concept of the ADDIE development model was chosen because of its advantages and disadvantages. Research and development (R&D) creates a new model or upgrades an existing item, such as hardware and software. We strive to develop valid and feasible learning materials in education, research, and development.

The terms engineering, strategy, approach, and model are often used in the context of training. There are several techniques to practice, from simple or traditional to the latest. This study, especially in training, is often referred to as technique, followed by the word strategy, then the term style, then the approach, and finally the model. An essential component in training is the training model technique. This approach is a systematic, structured, directed, and measurable way to achieve training objectives. Meanwhile, training is an activity that is carried out regularly with awareness, model, and duration long enough to reach the final goal of getting the desired training results, which is a very high achievement.

According to the Great Dictionary of Indonesian Language (2016), a model is an orderly and systematic way to achieve goals, especially those related to the

knowledge of the Language Development and Development Agency. The model is carried out to make it easier to carry out an activity and plan, and regular activities will allow the desired goals to be achieved gradually. An exercise model is a system or process for selecting the type of exercise and how to organize it based on the training load, complexity, and difficulty level. Running training in a modeled and organized manner during training is very important to improve athletes' readiness and training results.

Learning movement skills is a complex process that includes developing movement, coordination, and reflex skills. This technique consists of several systematic steps to improve mobility skills, including analysis, planning, development, and assessment. Skills are movements that follow specific patterns or forms that require coordination and control of part or all of the body, which can be done through the learning process (Sugiyono, 2017). Skills are classified into two types: Closed Skills and Open Skills. Motor learning theory explains how people learn or develop motor abilities through practice and experience (Schmidt and Lee, 2020). Motor learning is a relatively permanent behavior change due to training and experience, not due to growth and maturity.

Transfer in training is the capacity to apply previously acquired abilities to similar new circumstances or skills. In the reaction speed training model, the athlete can use his previously learned movement skills to help him develop his *dwi chagi* kick skills more quickly. The learning outcomes obtained and mastered can be intellectual proficiency, knowledge, motor skills (Bompa & Buzzichelli, 2019). The theory of skill learning also explains the stages people go through when acquiring new motor skills (dos Santos Banks et al., 2024). These stages can be used to construct a progressive reaction speed

training model depending on the athlete's ability level. Bisagno and Morra (2018) state that brain memory or cognitive aspects facilitate movement learning, thereby increasing tactical decision-making.

The term exercise comes from the United Kingdom terms "practice," "exercise," and "training." In Indonesian, these terms have the same meaning, namely training, but in the United Kingdom, they have different meanings. However, in reality, the term sport in the United Kingdom refers to comparable activities, especially physical activity (Jariono et al., 2024). Physical exercise that is done systematically, repeatedly, and programmatically will have a positive impact on the body, such as the following:

- 1) The heart will get bigger and stronger, increasing its volume.
- 2) A more significant number of capillaries around the muscles.
- 3) Increases the capacity of the blood to transport oxygen.
- 4) Increased capacity of muscle cells to produce energy
- 5) Increased muscle size.

The exercise developed in this study is to create *dwi chagi* kick skill training in taekwondo athletes for 14-16-year-olds. The training component is essential in improving the performance of athletes. There are four aspects of training that athletes must carefully analyze and develop. Here are four elements of the exercise, namely:

- 1) Physical exercise is a systematic, high-intensity physical activity with the primary goal of improving overall physical condition. Another study found that "the main goal of physical exercise is to increase physiological potential and develop the highest biomotor abilities so that the highest achievement can also be achieved" (Jariono et al., 2021).

- 2) Technique exercises: Technique exercises are systematic procedures performed to perfect exercise techniques. They aim to hone techniques, perfect movements, and consistently automate movements. Technical training is emphasized in all preparation and competition phases and must be balanced with physical, tactical, and mental training.
- 3) Tactical training refers to studying and developing tactics and using methods during competitions. (Zadoroznha, 2020) explains tactics as a sure way to win a match in sportsmanship or fairway while still complying with the rules. Tactical training is designed to improve players' interpretation skills. An athlete must integrate his movement methods into game patterns, formations, tactics, defensive techniques, and attacks to develop well and achieve perfect unity of movement. Tactical training aims to help athletes learn how to play effectively and efficiently and strengthen strategic abilities in the game.
- 4) Mental training refers to acquiring and developing sport-specific psychological traits such as thinking, focus, and personality. It is also known as psychological training. Mental training is a systematic and consistent approach to developing and consolidating the cognitive skills necessary for an athlete's performance to achieve optimal achievement. Mental training tries to improve talents such as focus skills, arousal control, thinking toughness, and motivation, all of which are essential to an athlete's success.

According to Lubis, "Adjusting the training load can be done by paying attention to the characteristics of the training load, namely: 1) Intensity, 2) Volume, 3) Duration, and 4) Frequency(Lubis et al., 2021)."

According to Bompa and Haff (2019), the principles of exercise are as follows: (1) Individual needs, (2) specialization, (3) the principle of progression, (4) overload, (5) recovery, and (6) reversibility. This is in line with Harsono (2015), "The principles of training that can support the improvement of achievement are the principle of excess weight, specialization, individualization, training intensity, training quality, training variety, training duration, relaxation training, and experimental tests."

Establishing a hypothesis is crucial when developing a model because it allows for change and analysis. The model needed is a single model, does not subtract from other vital factors, contains similarities, and is consistent with previous events. Budiwanto (2012) argues that the training model allows the coach to lead and manage the training time objectively, which can be compared to the match scenario(Budiwanto, 2012). However, each model has unique characteristics for each team and individual, thus posing problems for coaches and athletes. A training model considers athletes' psychological and physiological capacity, available facilities, and social environment.

The dwi chagi kick is used in martial arts such as Taekwondo. The motor movements in this kick are analyzed in terms of balance, coordination, flexibility, strength, rhythm and timing, attention, and concentration (Fachrezzy et al., 2021) (Wewege & Keir, 2018; Tomita et al., 2012). An in-depth study of the motor components of the dwi chagi kick is needed to maximize its performance. Here are each aspect of the motor component:

1) Balance

Good balance is indispensable when performing the dual change kick skill. The kicker must remain balanced on the kickstand while swinging the kicker's leg and returning to the starting position. The center of body mass must be placed correctly to avoid losing balance.

2) Coordination

An accurate and powerful kick requires good coordination between several body parts, such as the legs, hips, shoulders, and head. Coordinated movement allows effective power transmission from the footrest to the kicking foot.

3) Flexibility

Flexibility in the hips, back, and legs allows for a wider variety of kicks. It also helps to avoid muscle and joint injuries during the complicated movements of the *dwi chagi* kick.

4) Strength

Powerful kicks require strong leg, abdominal, and back muscles. Strength is also vital to maintain balance and stability during kicking movements.

5) Time (Timing)

Accurate timing settings in swinging and stopping the foot when kicking are essential to produce precise and powerful kicks in the event of an impact. This requires proper coordination between body and foot movements when kicking.

6) Focus and Concentration

One must have high focus and concentration to perform the intricate movements of the dual charge kick on target. The kicker must maintain concentration throughout the movements to achieve peak performance.

Reaction speed is essential in sports, especially those requiring quick stimuli response. This is important for sports that

require high motor coordination, such as gaming, martial arts, and athletics. Anticipation, transition, and reaction exercises are approaches to increasing reaction speed. Age, gender, fitness level, and physical and mental condition all impact reaction speed. The reaction speed usually increases with age until it peaks between 20 and 30, after which it decreases. Gender also affects reaction speed, with men typically having faster reaction times than women. The reaction speed can be measured using basic, optional, and complex tests. Dewi (2009) said reaction speed is the shortest time needed to give a kinetic answer after receiving a stimulus (Arsyad et al., 2018; Velocidad et al., 2023). This is because the reaction time, movement time, and response time are different from the reaction time in the thought process.

Speed is an essential motor component in every sport, whether a match, race, or match (Pryimakov et al., 2022; Tsegay et al., 2021; Yulanda & Jariono, 2023). Therefore, speed is one of the critical elements of motor that must be trained to support athlete achievement. The smallest time required to respond to a stimulus kinetic is called reaction velocity. This is due to three temporal components: reflexes, movement, and response time. Reflex time is the time it takes to transmit impulses from sensory neurons to the reflex center, the efferent nerve, and the effector. At the same time, reaction time refers to the thought process in which input is received by afferent neurons, transported to the central nervous system, and administered to the effector. Reaction speed is essential for the effectiveness of taekwondo kick training, which has an impact on performance and success in various disciplines. Research has revealed that reaction time is crucial in sports such as Taekwondo, which prioritizes speed and agility of movement. Irfan et al. (2022). It is argued that the fight reaction speed

exercise and the taekwondo reaction speed exercise have been created to increase reaction time through focused training. In addition, the relevance of reaction time in taekwondo kicks has been emphasized, which suggests that a faster reaction results in a more precise kick, ultimately changing the reaction time's outcome. Reaction speed is a latent (hidden) process that cannot be observed, so Syafruddin (2011) identified five steps of the reaction speed process, namely: 1) stimuli or stimuli enter the stimulus receiving apparatus (receptors), 2) are brought to the central nervous system in the brain, 3) stimuli are transmitted or converted into the nervous network and form effector signals, 4) signals from the nervous system enter the muscles, and 5) muscle contractions occur.

An electronic body reaction is a tool that will be used as a training medium to increase reaction speed and become a tool to create test data, measurements, and evaluation materials. The design of an electronic body reaction system requires a combination of integrated hardware and software components to provide optimal results. The light stimulus module is the main component of this tool; the LED light on the tool will be a cue for implementing the programmed movement skills. Another critical component is the push button reaction speed. This push button must be able to identify the response of the kick to the light stimulus with precision and reliability. Proper reaction time measurement is the basis for analyzing and improving the reaction speed of athletes. The controller software is a vital component that controls the entire electronic body reaction system. The software runs on a microcontroller to regulate the data flow from the push button, display the light stimulus, and calculate the reaction speed and accuracy of the presentation.

Overall, advances in technology-based reaction speed training tools have created many opportunities for athletes from different sports to improve their skills. Coaches and sports scientists can use state-of-the-art sensors, virtual simulations, and advanced data analysis to create more effective and tailored training programs to maximize athletes' potential.

METHODS

Researchers in this paper are working on model development, trying to create and innovate in the design of existing or new electronic body reaction-based reaction speed training models to solve a problem. As with the dwi chagi kick exercise, research and development (Research & Development) will produce a reaction speed training model based on electronic body reaction in the dwi chagi kick skill training for taekwondo athletes aged 14-16 years. This research is intended to produce a new and valuable addition to advancing science in Taekwondo, especially in exercise, biomechanics, and physiology.

1. Research Place: This research was conducted at Taekwondo Backpacker Indonesia
2. Research Time: The research was conducted in January – June 2024.

Planning and drafting were made to explicitly create this training model to improve the ability of kicking skills Dwi Chagi in taekwondo athletes aged 14-16 years using a reaction speed training model based on electronic body reaction. The physical aspect of this exercise model focuses on developing the strength, flexibility, balance, coordination, and endurance necessary to perform an excellent dual chai kick. The mental aspects of this training technique

include increased focus, concentration, visualization, and emotional control, all of which are necessary to perform kicks Dwi Chagi accurately and effectively. This exercise model takes a gradual approach, starting with simple movements and progressing to complex movements that include physical, mental, and technical elements. With the characteristics of the developed model, it is hoped that the kick training model Dwi Chagi with a reaction velocity-based training model electronic body reaction can provide the best benefits for improving the ability and performance of taekwondo athletes aged 14-16 years in kicking Dwi Chagi effectively and efficiently.

Research Approaches and Methods

This study uses development research to create a training model, specifically the reaction speed and accuracy of the dual charge kick for taekwondo athletes between the ages of 14 and 16. The ADDIE model was chosen as the model development because of its systematic sequence of activities and its ability to handle the challenges of the training process, including training model materials suitable for students' needs and characteristics.

The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model is a research approach that involves selecting research participants using various factors. This includes intentional or consideration-based sampling at the analysis stage, convenience-based sampling at the design stage, expert sampling at the development stage, and cluster or area sampling at the implementation stage. Experts or specialists are selected to provide input and evaluation at the design stage. At the development stage, product test subjects are chosen based on relevant

criteria and convenience sampling. In the implementation stage, cluster or area sampling selects a specific group or area as the research subject. Simple or systematic random sampling ensures that every individual in the population has an equal chance of being chosen as a research subject. At the assessment stage, deliberate or judgemental sampling is used to select evaluation participants based on relevant criteria and appropriate samples.

Model Development Planning

In this study, for the research and development of an electronic body reaction-based dual kick reaction speed training model in Taekwondo Athletes Aged 14-16 Years, the researcher chose to use ADDIE's research and development (R&D) technique. The main objective of this study was to create a model of reaction speed and dual kick accuracy training for 14-16-year-old taekwondo athletes, and a Research and Development (R&D) approach was appropriate to design and evaluate the model. The five steps of R&D, according to ADDIE, are as follows:

1. **Analysis:** At this stage, the researcher will analyze the exercise model's needs, reaction speed, and accuracy of dual charge kicks for taekwondo athletes aged 14-16.
2. **Design:** At this stage, the researcher will thoroughly design the exercise model to measure reaction speed and accuracy of the direction of the dwi chagi kick. Activities that can be completed include making an exercise implementation plan (EIP), designing training materials, producing training media, and designing assessment instruments.
3. **Development:** The development stage is carried out by combining pre-designed components and re-correcting the training model, reaction

speed, and accuracy of the direction of the dual charge kick before validation. This stage involves creating a product validity model for 3 experts: one taekwondo expert lecturer, one taekwondo professional trainer, and a measuring instrument expert. The goal is to ensure the validity and effectiveness of the product in training taekwondo athletes on dwi chagi kicking skills.

4. Implementation: The development of a training model for reaction speed and accuracy of the direction of the dwi chagi kick in Taekwondo involves several stages. First, experts who provide input, suggestions, and improvements test the model for feasibility. The input was then used to improve the model in Draft I of the taekwondo branch, thus producing a model that had been revised in Draft II of the taekwondo branch.
5. Evaluation: At this stage, an assessment is carried out; this evaluation stage is essential for ensuring the success of the exercise model that has been developed and implemented.

Data Collection Instruments

This study collects data using a questionnaire or checklist with two stages: product validation and testing. A measurement scale is required to assess the research. The research instrument used in this study is to analyze the needs of the questionnaire/questionnaire using the following: (a) expert evaluation instruments, (b) pre-test and post-test, and (c) Taekwondo dual kick test instrument that has been developed to measure the ability of the pisco motor technique of the dwi chagi kick.

1. Expert Evaluation Instrument (Model Eligibility)

It is divided into three levels of criteria: easy difficulty, medium

difficulty, and complex difficulty. Six models (accessible), ten medium models, and 14 complex models were carried out from each difficulty level for a total of 30 training models.

Prof. Widiastuti, M. Pd., a test and measurement expert, carried out the expert evaluation.

2. Expert Evaluation Instrument (Product Qualification)

This evaluation instrument assesses the feasibility of the exercise equipment product and dwi chagi kick measuring instrument through the developed reaction speed training model. With the creation of 3 assessment aspect criteria, including general, hardware, and display aspects. Each item of each assessment aspect amounted to 8 out of a total of 24. Hilarius Wira Widya Iswara, M. Pd., an electronics and informatics expert, carried out the expert evaluation.

3. Dwichagi Taekwondo Kick Test Instrument

Test Name: Dwi chagi kick skill test

The purpose of the Test is to measure the level of reaction speed and accuracy of the direction of the kick Dwi Chagi-based Electronic body reaction in athletes 14-16 years old before and after the application of the dual kick training model through the reaction speed training model. The expert evaluation was carried out by Evi Susanti, and Reza Irwansyah, as taekwondo experts.

Validity and Realism of the Instrument

Experts can assess validity, while construction validity (expert judgment) can be determined through factor analysis. The validity and reliability of the instrument are very important for obtaining credible and trustworthy research data, thus ensuring confidence in the research results.

Data Analysis Techniques

The data analysis technique used in the research "Development of Electronic Body Reaction-Based Dwi chagi Kick Reaction Speed Training Model" is the type of evaluation used by the researcher, which includes result evaluation, descriptive analysis, effectiveness test, and feasibility analysis.

Feasibility analysis evaluates the feasibility of the training model using the Likert scale and specific criteria. Using the data analysis technique, the researcher seeks to draw findings and provide recommendations based on the effectiveness and feasibility of the taekwondo dwi chagi kick training model with the reaction speed training model. The quantitative data obtained from the questionnaire was then converted into qualitative data with a scale of 5 (Likert scale) to determine the quality of the exercise model with the following description:

| | |
|-------------|----------|
| Very Less | Scored 1 |
| Less | Scored 2 |
| Pretty Good | Scored 3 |
| Good | Scored 4 |
| Excellent | Scored 5 |

Validation analysis of media experts and material experts uses a rating scale. The formula for calculating the rating scale is as follows (Sugiyono, 2017)

$$P = \frac{\text{data collection result score}}{\text{ideal score}} \times 100\%$$

Information:

P = percentage figure,

Ideal score = highest score per item x
number of respondents x
number of items.

Furthermore, the data from the calculation is translated into qualitative data using an interpretation scale. The scale is obtained by dividing the criterion (ideal) score by the number of answer

intervals. Since there are five answer intervals on this instrument, the interpretation scale used is as shown in Figure 1. as follows:



Figure 2. Media Qualification
(Sugiyono, 2017)

The researcher used the criteria referred to by (Arikunto, 2011). The following table of eligibility criteria can be seen in Table 1:

Table 1. Eligibility Criteria

| Validity Rate (%) | Information |
|-------------------|---------------|
| 81-100 | Very worthy |
| 61-80 | Proper |
| 41-60 | Quite decent |
| 21-40 | Not eligible |
| 1-20 | Very unworthy |

Source : (Arikunto, 2011)

RESULT

Model Development Results

This study was conducted to create an electronic body reaction-based dwi chagi kick reaction speed training model for taekwondo athletes aged 14-16 years. This study aims to test the feasibility of the dwi chagi kick reaction speed training model developed using data from material experts, expert media, and athletes. This research adheres to the ADDIE development approach, which stands for Analysis, Design, Development, Implementation, and Evaluation.

1. Results of the Analysis Stage

The questionnaire was used to collect data on analyzing the needs of 30 athletes aged 14-16. The 30 athletes

who were respondents were those who were learning the basics of dual-chain engineering skills.

Taekwondo athletes need a training model to increase the reaction speed of the dwi chagi kick, so they need clear and measurable feedback for evaluation. Although the exercise experience varies, common obstacles include balance, coordination, and speed. Training models can help improve reaction speed, kick accuracy, and leg strength while addressing athletes' challenges in maintaining balance, coordination, and movement speed.

Taekwondo coaches have used various training methods to increase the reaction speed of the dwi chagi kick. These methods include stimulus response exercises, dwi chagi kick pattern exercises with varying times, and technological aids such as speed sensors and high-speed cameras. The information from the interview is essential for researchers in designing a dwi chagi kick reaction speed training model that suits the needs and actual training practices on the field.

To develop a model of dual charge kick reaction speed training, biomechanics experts suggest using plyometric exercises and weight training to improve the strength and explosiveness of leg muscles, eye-foot coordination exercises, reactions to various visual/audio stimuli, and the utilization of technology to measure and provide accurate responses.

2. Results of the Design Stage

Exercises at the difficulty level easily focus on basic exercises, while intermediate levels add complexity with various techniques and patterns. Complex levels simulate challenging match situations with limited response times and external distractions. This

tool's feedback helps athletes continuously improve their reaction speed and kick accuracy.

3. Feasibility Test Results

Calculations using Aiken's V show that the average V index is $0.86 > 0.79$ (V of Aiken's table). This proves that all items contained in the questionnaire represent the measured construct and are said to have sufficient content validity. Thus, the electronic body reaction-based kick reaction speed training model is valid and can be used as a training program.

4. Evaluation of the Exercise Model

Researchers have concluded that the suggestions and inputs include: (1) electronic body reaction media must have sensor sensitivity for accurate reaction time measurement, (2) emphasis should be given to exercises that train key elements in kick reaction speed, such as anticipation, decision-making, and neuromuscular coordination, (4) describe the distance between electronic body reaction and athletes distinguish the distance between men and women, and (5) More detailed instructions for movement stages in the description of the model item so that the coach or athlete will later more easily understand the training item in question.

CONCLUSION

Based on all the data obtained from the results of expert validation and through several stages of validation, the researcher can conclude that the reaction speed training model based on electronic body reaction in the dwi chagi kick skill training for taekwondo athletes aged 14-16 years can be applied at that age. It can be seen

from the results of the pretest and posttest of the exercise model applied that the change is significant.

REFERENCES

- Arikunto, S. (2011). *Dasar-dasar evaluasi pendidikan*. Bumi Aksara. <https://books.google.co.id/books?id=C9L5jwEACAAJ>
- Arsyad, P., Hanif, A. S., & Tangkudung, J. (2018). The Effect Of Explosive Power Leg Muscle, Foot-Eye Coordination, Reaction Speed And Confidence In The Ability Of The Crescent Kick. *JIPES - Journal Of Indonesian Physical Education And Sport*. <https://doi.org/10.21009/jipes.041.13>
- Bompa, T. O., & Buzzichelli, C. A. (2019). Periodization: Theory and Methodology of Training. In *Journal of Chemical Information and Modeling* (Vol. 53, Issue 9).
- Bozkurt, S. (2023). The effect of Taekwondo training applied with differential learning approach on the technical skills. *Sportis*, 9(0), 1–23.
- Bridge, C. A., Ferreira Da Silva Santos, J., Chaabène, H., Pieter, W., & Franchini, E. (2014). Physical and physiological profiles of Taekwondo athletes. *Sports Medicine*, 44(6), 713–733. <https://doi.org/10.1007/s40279-014-0159-9>
- Budiwanto, S. (2012). Metodologi Latihan Olahraga. In *FIK Universitas Negeri Malang*.
- dos Santos Banks, L., Santiago, P. R. P., da Silva Torres, R., de Oliveira, D. C. X., & Moura, F. A. (2024). Accuracy of a markerless system to estimate the position of taekwondo athletes in an official combat area. *International Journal of Performance Analysis in Sport*, 00(00), 1–16. <https://doi.org/10.1080/24748668.2024.2321738>
- Fachrezzy, F., Maslikah, U., Hermawan, I., Nugroho, H., Jariono, G., & Nurulfa, R. (2021). Kicking ability for the eolgol yoep chagi taekwondo poomsae in terms of quality of physical condition, self-confidence, and comparison of leg muscle explosive power and core stability. *Journal of Physical Education and Sport*, 21(4), 2337–2342. <https://doi.org/10.7752/jpes.2021.s4313>
- Hariadi, N., Hartono, S., Widodo, A., Muhammad, H. N., & Setiawan, D. (2023). Effectiveness of Technical Skills Attacking Senior Athlete Kyourugi at the 2023 World Taekwondo Championship in Baku, Azerbaijan. *International Journal of Emerging Research and Review*, 1(3), 000041. <https://doi.org/10.56707/ijoerar.v1i3.41>
- Jariono, G., Nurhidayat, N., & Indarto, P. (2024). Physical Activity Training Methods to Improve the Physical Condition of Volleyball Players : A Systematic Review. *Physical Education Theory and Methodology*, 24(1), 118–129. <https://doi.org/10.17309/tmf.v.2024.1.15>
- Jariono, G., Nurhidayat, N., Nugroho, H., Nugroho, D., Amirzan, A., Budiman, I. A., Fachrezzy, F., Sudarmanto, E., & Nyatara, S. D. (2021). Strategies to improve jump service skills at volleyball student activity unit of Muhammadiyah University of Surakarta. *Linguistics and Culture Review*, 6(July 2021), 37–48. <https://doi.org/10.21744/lingcure.v6ns3.1906>
- Jia, M., Liu, L., Huang, R., Ma, Y., & Zheng, W. (2024). Correlation analysis between biomechanical

- characteristics of taekwondo double roundhouse kick and effective scoring of electronic body protector. *Frontiers in Physiology*, 14(January), 1–13. <https://doi.org/10.3389/fphys.2023.1269345>
- Kim, J. (2021). Wearable Bioelectronics: Enzyme-based body-worn electronic devices. *HHS Public Access*, 176(1), 100–106. <https://doi.org/10.1021/acs.accounts.8b00451>
- Lubis, J., Sukur, A., Fitrianto, E. J., Suliyanthini, D., Irawan, A. A., Robianto, A., Haqiyah, A., & Oktafiranda, N. D. (2021). Wearing a fibrous protein (cv-f) cooling vest to reduce fatigue among indonesian pencak silat athletes: Is it effective? *Journal of Engineering Science and Technology*, 16(2), 1402–1415.
- Moenig, U., Kim, M., Choi, H., & Sim, S. (2023). An Update on the Rule and Scoring Equipment Modification Issues of the World Taekwondo (WT) Competition System. *Ido Movement for Culture*, 23(1), 44–52. <https://doi.org/10.14589/ido.23.1.6>
- Podrigalo, L., Romanenko, V., Podrihalo, O., Iermakov, S., Huba, A., Perevoznyk, V., & Podavalenko, O. (2023). Comparative analysis of psychophysiological features of taekwondo athletes of different age groups. *Pedagogy of Physical Culture and Sports*, 27(1), 38–44. <https://doi.org/10.15561/26649837.2023.0105>
- Pryimakov, O., Eider, J., Mazurok, N., & Omelchuk, O. (2022). Relationships between the parameters of physical development , speed and strength fitness , and special work capacity of highly skilled combat athletes. *Journal of Physical Education and Sport*, 22(2), 346–354. <https://doi.org/10.7752/jpes.2022.02044>
- Shinkfield, D., & Stufflebeam, A. (2007). *Teacher evaluation: Guide to effective practice. Evaluation in educational and human services* (Issue 2).
- Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: PT Alfabet. In Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: PT Alfabet.
- Syaifullah, R., & Doewes, R. I. (2020). Pencak silat talent test development. *International Journal of Human Movement and Sports Sciences*, 8(6), 361–368. <https://doi.org/10.13189/saj.2020.080607>
- Tsegay, M., Mondal, S., Mekonen, H. K., & Berhanu, T. (2021). Effect of Varied Intensity of Football Specific Circuit Training on Agility , Speed and Explosive Strength among U-17 Football Players in Ethiopia. *Indian Journal of Public Health Research & Development*, 12(2), 537–541.
- Velocidad, E. D. E., En, D. E. R., & Voleibol, E. L. (2023). REACTION SPEED TRAINING IN VOLLEYBALL. *Rev Bras Med Esporte*, 29, 1–4.
- Yao, Y. (2023). Application of Sports Biomechanics in the Technical Analysis of Taekwondo Kicking. *Revista Brasileira de Medicina Do Esporte*, 29, 2022–2024. https://doi.org/10.1590/1517-8692202329012022_0379
- Yulanda, M. N., & Jariono, G. (2023). *Analysis of the Physical Fitness of Trained Individuals in Power, Speed, and Agility: A Descriptive Study*. Atlantis Press SARL. https://doi.org/10.2991/978-2-38476-086-2_104
- Zadoroznha, O. (2020). Tactical training of elite athletes in Olympic combat

sports: practice and experience.
Trends in Sport Sciences, 27(2), 71–
85.
<https://doi.org/10.23829/TSS.2020.27.2-4>