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Pencak silat reaction speed training model: training for pencak silat athletes aged 17—21 years
Modelo de entrenamiento de la velocidad de reacción en pencak silat: entrenamiento para atletas de pencak silat de entre 17 y 21 años

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Abstract. This research aims to produce products and test the effectiveness of reaction speed training models for Pencak Silat athletes aged 17—21 years. Evaluation by experts using two Pencak Silat experts and one Pencak Silat expert lecturer. This research method uses the Borg and Gall research and development (R&D) model. The research subjects were Pencak Silat athletes aged 17—21 years with a total of 18 subjects for the small trial, 100 people for the large trial and 60 people for the effectiveness test consisting of 30 people in the experimental group and 30 people in the control group. The instruments used were questionnaires, interviews and observations and to measure the reaction speed of Pencak Silat athletes using a Reaction Speed of 10 seconds. The results of the N-gain Percent test for the experimental group obtained a Mean value = 77.4 or equal to 77%, which is included in the effective category. Meanwhile, the N—Gain Percent test results for the control group obtained a Mean value = 23.2 or equal to 23%, which was included in the ineffective category. So it can be concluded that the reaction speed training model is effective in increasing the reaction speed of Pencak Silat athletes aged 17—21 years.
Keywords: Training Model, Reaction Speed, Pencak Silat

Resumen. El objetivo de esta investigación es elaborar productos y probar la eficacia de los modelos de entrenamiento de la velocidad de reacción para atletas de Pencak Silat de entre 17 y 21 años. Evaluación por expertos mediante dos expertos en Pencak Silat y un profesor experto en Pencak Silat. Este método de investigación utiliza el modelo de investigación y desarrollo (I+D) de Borg y Gall. Los sujetos de la investigación fueron atletas de Pencak Silat de edades comprendidas entre los 17 y los 21 años, con un total de 18 sujetos para la prueba pequeña, 100 personas para la prueba grande y 60 personas para la prueba de eficacia, consistente en 30 personas en el grupo experimental y 30 personas en el grupo de control. Los instrumentos utilizados fueron cuestionarios, entrevistas y observaciones y para medir la velocidad de reacción de los atletas de Pencak Silat se utilizó una Velocidad de Reacción de 10 segundos. Los resultados de la prueba de Porcentaje de Ganancia N para el grupo experimental obtuvieron un valor Medio = 77,4 o igual a 77%, que se incluye en la categoría eficaz. Mientras tanto, los resultados de la prueba de Porcentaje de Ganancia-N para el grupo de control obtuvieron un valor Medio = 23,2 o igual a 23%, que se incluyó en la categoría de ineficaz. Por lo tanto, se puede concluir que el modelo de entrenamiento de la velocidad de reacción es eficaz para aumentar la velocidad de reacción de los atletas de Pencak Silat de entre 17 y 21 años
Palabras clave: Modelo de entrenamiento, velocidad de reacción, Pencak Silat

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Introduction

Pencak Silat is an ancestral heritage that has existed for generations (Lubis et al. 2022). Pencak Silat, which originated in Indonesia, has been recognized as an intangible world cultural heritage by the UNESCO World Body. In addition, Pencak Silat, which reflects Indonesian culture as a whole, has become a symbol of the unity of the Indonesian nation (Herdiman, Lubis, dan Yusmawati 2022). Various age groups, male and female, are attracted to the sport. In elementary schools, junior high schools, high schools, and colleges, Pencak Silat matches are started, showing that the Indonesian government pays attention to Pencak Silat (Ridwan et al. 2022). Each district or province must participate in Pencak Silat in national championships such as POPNAS, POMNAS, KEJURNAS, POPROV, and PON.

In terms of performance, an athlete must diligently and optimally practice the physical components that support his performance. In the physical component, there are three things that are important for martial arts athletes, namely reaction action, coordination and speed (Alfin Adam 2022). These three things are closely related to several techniques needed in Pencak Silat, namely kicking, punching, parrying and throwing techniques. Good action will benefit the athlete in carrying out attacks either through kicks or punches (Shalihudin 2021). Apart from that, with good reactions athletes are not easily attacked because they are quick to respond using their parries.

The Pencak Silat achievements of South Sulawesi athletes at the last PON championship or XX PON were held in Papua in 2021. It cannot be said to be encouraging. The failure of the South Sulawesi fighters could be caused by technical and non-technical factors. This is supported by the quote (Riyan, Rahayu, dan Wahyudi 2019) that, "the training material is just experience as if it seems boring and monotonous, athlete training is not well programmed, training is only incidental and not continuous, what is obtained is not optimal, and not many use more modern training methods based on research. The non-technical factors include, among others, management's attention which is felt to be less than optimal in running the program, management that is not professional and lack of funds for sports which has been a classic problem in South Sulawesi province.

The existing training still uses the traditional model. It is not uncommon for Pencak Silat trainers to only be guided by the higher "belt" mark. At a level that is considered to have more knowledge, coaches only teach what exercises

they usually get from teachers or warriors who use more traditional elements, as well as from former athletes who do not have the appropriate competence in their educational background in the world of sports. This explanation is supported by (Ridwan et al. 2022) quote that, "considered to have more knowledge, coaches only teach what exercises they usually get from teachers or warriors who have more traditional elements in raising athletes."

The main factor that can spur the development of sports achievements is improving the quality of training and coaching. Improved training and coaching can be achieved by applying scientific and technological disciplines. This is as quoted by (Janner-Klausner dan Deller 2021) that, Increasing performance must be through training carried out with a scientific approach to related sciences such as sports psychology, biomechanics and sports physiology. To improve performance, training must be carried out with a scientific approach to relevant sciences (Angelov et al. 2022). Sports include fields such as sports psychology, biomechanics, and exercise physiology. With the help of these disciplines, effective training theories can be developed, which will help improve sports performance in South Sulawesi Province.

Efforts to develop training programs to improve performance must pay attention to 4 (four) aspects, namely (1) technical aspects, (2) physical aspects, (3) tactical aspects, (4) mental aspects (Bompa dan Haff 2019). These four aspects must be trained in the correct ways and methods so that each aspect can develop optimally. This is supported by a quote (Henry et al. 2020) that "tactics are conditioned by having experience in learning and developing mental skills which are reflected in self-confidence, aggressiveness and the need for achievement". From a technical perspective, Pencak Silat techniques and tactics do not encounter significant obstacles because they have undergone a process of developing and training these skills.

The mental aspect is reflected in self-confidence, aggressiveness, and the need for achievement (Tangkudung et al. 2021). However, from a physical perspective, it appears that this aspect requires further development (Tangkudung et al. 2022). There are not many books that discuss physical conditioning training, as can be seen from the limited number of instruments for the Pencak Silat sport. For example, it is not yet known what type of training and energy system is right for Pencak Silat sports. (Wile 2020) states that training must be specific, aimed at the energy system used and specific to movement patterns that are appropriate to sports skills. The explanation is as quoted. determines an athlete's ability to complete a training program and be in good physical condition when playing in a match.

Speed is very necessary and can affect a person's performance both when attacking and defending (Bowman et al. 2023). A good reaction will benefit the athlete in attacking both through kicks and punches. Good reaction speed, especially to visual stimulation, is very important in combat sports because it will help athletes gain points (Penna, Dickerson, dan Wu 2023). An athlete can use reaction drills in a broad training program to improve their body control and technique if they frequently demonstrate the ability to do so (Anggelia, Ramadi, dan Juita 2021).

Researchers conducted interviews with coaches and athletes and created a questionnaire with questions about reaction speed training. Observation results show that fighters in the sparring category use conventional techniques to train reaction speed. Another finding was that the exercises used relied solely on intuition. What is remembered at that moment is also rehearsed. In addition, the trainers interviewed simultaneously stated that the lack of a guidebook for training reaction speed for fighters in the sparring category has resulted in limitations in providing a reaction speed training menu for the sparring category. As a result, the physical training methods for sparring category fighters had to be changed. To increase understanding of problems in the field, data support is needed in addition to observation results. The results of the needs analysis will be expressed through data support. As a result of the needs analysis carried out by distributing questionnaires to fighters in the sparring category, it can be concluded that the development of the reaction speed training model for the sparring category was successful with a percentage of 71.55 percent. The existence of supporting data strengthens the need to develop reaction speed training models.

Several studies show the importance of reaction speed in several martial arts sports such as Aikido (Korkusuz et al. 2017), Boxing(WEINAN dan Cho 2021), Capoeira (Dymel dan Szyliński 2020), Judo Kickboxing (AKMAN, ORHAN, dan ÇİMEN POLAT 2018), Taekwondo (He dan Wan 2022) (Bennington 2019), Muaythai (Ihsan et al. 2022), Mixed martial arts (MMA) (Beranek et al. 2020), (Polechoński dan Langer 2022), kalarippayattu (Nandha dan Suresh 2024), jiujitsu (Kim dan Nam 2020), karate (Jakhel 2019), (Oliveira et al. 2019), Wrestling (Telles dan Barreira 2020), Martial arts (Kwak dan Song 2024), (Mülhim dan Akcan 2022) and Pencak Silat (Sinulingga, Kasih, dan Pasaribu 2023). Previous studies show that there is no comprehensive reaction speed training model for the sport of Pencak Silat.

Material and Methods

Participant

This study is an experimental research designed with pretest and posttest groups. This study was conducted at the FIK UNM gymnastics hall. The exercise program lasts for eight weeks and is carried out three times a week, on Mondays, Wednesdays and Fridays. This research involved BKMF Pencak Silat BEM FIK UNM athletes and UKM Pencak Silat hasanuddin university aged between 17—25 years. A total of 60 Pencak Silat athletes aged between 17—25 years were divided into two treatment groups with 30 subjects each. Treatment group 1 did reaction speed training which combined general, special reaction speed and games,

and treatment group 2 did physical training using conventional methods.

Research Procedure

The present study falls under the category of developmental research. the research model used is Borg and gall, This study used 10 steps in research and development:

1. Research and information collecting, begin by conducting initial research and collecting information, which may involve on-site observations and a review of relevant literature.
2. Planning, planning to formulate the concept of a reaction speed training model for Pencak Silat athletes
3. Develop preminary form of product, Creating a reaction speed training model for Pencak Silat athletes
4. Preliminary field testing, Analysis of expert assessments carried out by two Pencak Silat experts and one Pencak Silat expert lecturer, as well as small group trials which included questionnaires, consultations and evaluations.
5. Main product revision, Revision based on the results of expert judgment.
6. Main field testing, Model revision based on the results of expert evaluation and small group trials.
7. Operational product revision, This revision is used to improve the initial model created by the researcher.
8. Operational field testing, Large group trial using a recently revised model.
9. Final product revision, Refinement of the ultimate model in accordance with the findings from field experiments.
10. Dissemination and implementation.

The following 10 stages of the development method will be explained in the following image

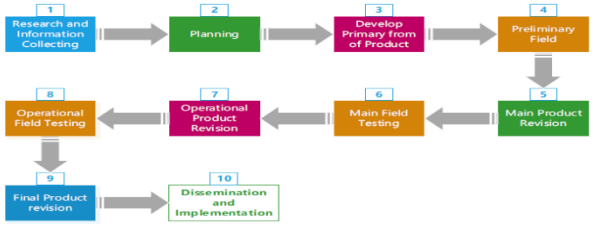

Figure 1. stages of the development method

Table 1.
Summary of Instrument Validity Test for reaction speed

Correlations			
		Reaction Speed 1	Reaction Speed 2
Reaction Speed 1	Pearson Correlation	1	.761**
	Sig. (2-tailed)		.000
	N	64	64
Reaction Speed 2	Pearson Correlation	.761**	1
	Sig. (2-tailed)	.000	
	N	64	64

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the table above, the correlation coefficient is 0.761 with a p-value of 0.000 < alpha (0.01) so that with this value it can be concluded that the reaction speed test instrument used is valid.

Table 2.
Summary of Reliability Test for Reaction Speed Instrument

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.864	.864	2

An instrument is said to be reliable if it has a reliability value> 0.6. Based on the reliability test table above, the reliability value is 0.864> 0.6 so it can be concluded that the reaction speed instrument can be said to be reliable.

Data Analysis

Data analysis techniques carry out analysis descriptive statistics, Wilcoxon text, and Mann-Whitney test where all data processing is carried out with computer assistance using SPSS 21 application for Windows.

Results

Study This aim for see effectiveness exercise speed reaction athlete Pencak Silat ages 17 to 25 years. As for the results deep data analysis study this can seen as following.

Table 3.
Descriptive Pretest and Posttest Statistics

Description	Experimental Group		Control Group	
	Pretest	Postest	Pretes	Posttest
Mean	8.5	14.3	7.9	9.3
Std. Deviation	1.3	1.4	1.3	1.3
Min	7	12	4	7
Max	12	16	10	12

Before being given treatment, namely 70 modified reaction speed training models for Pencak Silat aged 17-21 years, the experimental group obtained an average score of 8.5 and after being given the reaction speed training model the average value increased by 14.3. Meanwhile, for the control group pre-test, the average score was 7.9 and the control group post-test obtained a score of 9.3. So, it can be concluded that there was a higher increase in reaction speed training for Pencak Silat athletes aged 17-21 years for the experimental group compared to the control group.

Table 4.
Data Normality Test

Normalitas	Experimental Group		Control Group	
	Pretest	Posttest	Pretest	Posttest
Kolmogorov-Smirnov	0.014	0.006	0.003	0.023
Shapiro-Wilk	0.026	0.021	0.015	0.041

Based on the results of the analysis in the table above, it shows that all data from both the experimental group and the control group have a p value <0.05. Because all data from both groups is <0.05, all data is not normally distributed. Therefore, to answer the hypothesis, a non-parametric t test was carried out consisting of the Wilcoxon test to see the increase in the two groups and the Mann-Whitney

test to see the difference in reaction speed between the experimental group and the control group.

Table 5.
Wilcoxon test

Wilcoxon Test	Experimental Group		Control Group	
	Pretest	Posttest	Pretest	Posttest
Mean	8.5	14.3	7.9	9.3
p (significant)	0.000		0.000	

The Wilcoxon test results showed that the experimental group experienced an increase in the average pretest (8.5) to posttest (14.3) with a significance value of p (0.000) <0.05. Because the significance value in the experimental group was <0.05, there was an increase in reaction speed in Pencak Silat athletes aged 17-21 years. Likewise, the control group experienced an increase in the average pretest (7.9) to posttest (9.3) with a significance value of p (0.000) <0.05. Therefore, the control group also experienced an increase in reaction speed in Pencak Silat athletes aged 17-21 years. The results of the Wilcoxon test in both groups showed that the average increase was higher in the experimental group.

Table 6.
Mann-Whitney test

Kelompok	N	Mean Rank	p (mann-whitney test)
Eksperimen	30	44.8	0.000
Kontrol	30	18.0	

The results obtained are presented in table 4 which shows that there is a significant difference in Pencak Silat athletes aged 17-21 years between the experimental group and the control group (p = 0.000). This means that reaction speed training given to Pencak Silat athletes aged 17-21 years can increase reaction speed compared to conventional training. This can also be seen based on the mean rank scores of the two groups, where the Experimental Group (M = 44.8) is higher than the Control Group (M = 18.0).

The N—Gain Score calculation can refer to the table below, which refers to the N—Gain Score, namely high, medium and low.

Table 7.
N—Gain Score

N-gain value	Interpretation
> 0.7	high
0.3 – 0.7	medium
< 0.3	low

Source: (Meltzer 2020)

Table 8.
Test N—Gain Score

	Group	Mean	Std. Deviasi	Information
NGain_Score	Experiment	0.77	0.18	High
	Control	0.23	0.22	Low

The results of the N—Gain Score test for the experimental group obtained a Mean value = 0.77 which is included in the high category. Meanwhile, the N—Gain Percent test results for the control group obtained a Mean value = 0.23 which is included in the low category. The N—Gain Percent calculation can refer to the table below, where when referring to N—Gain Percent, namely effective, quite effective, less effective, and Ineffective.

Table 9.
N—Gain Percent

N-gain value	Interpretation
< 40	Ineffective
40 – 55	Less effective
56 – 75	Quite effective
> 76	Effective

Source: (Hake 2022)

Table 10.
Test N—Gain Percent

	Group	Mean	Std. Deviasi	Information
NGain_Percent	Experiment	77.4	17.6	Effective
	Control	23.2	22.8	Ineffective

The results of the N—Gain Percent test for the experimental group obtained a Mean value = 77.4 or equal to 77%, which is included in the effective category. Meanwhile, the N—Gain Percent test results for the control group obtained a Mean value = 23.2 or equal to 23%, which was included in the ineffective category.

In Pencak Silat, reaction speed is one of the necessary physical components. Pencak Silat athletes can perform Pencak Silat techniques well, avoid attacks, and move quickly if they have good reaction speed. When Pencak Silat athletes carry out reaction speed training thoroughly, continuously, and systematically programmed, their reaction speed will increase significantly. The test results showed that reaction speed training increased the reaction speed of Pencak Silat athletes aged 17—21 years. Thus, it can be concluded that after using the Pencak Silat reaction speed training model, the reaction speed of athletes aged between 17—21 years increased significantly.

Discussion

Assessed attacks in match Pencak Silat is attacks that use pattern steps, no unobstructed, steady and powerful, and composed in coordination technique good attack (Hidayat dan Haryanto 2021), For do attack as described in the Hidayat et.al. then required exists speed good reaction. Related with fast reaction (Haqiyah et al. 2023) explain Speed reaction is abilities in individuals for respond stimulation or stimulus optical (eyes), tactile (skin), and acoustic (ears). (Siregar, Soegiyanto, dan Rustiadi 2021) says reaction speed is the quality that enables an organism to initiate kinetic reactions as quickly as possible after receiving a stimulus. Therefore, reaction speed can also be defined as the ability of an organism to respond to a stimulus as quickly as possible to achieve optimal results.

For can obtain mark in match Pencak Silat, athlete must equipped with technique good attack and defense. This matter Because principle base match Pencak Silat is get points with do attack and defense in the match Pencak Silat can use many kinds of technique attack For drop against (Gustama, Firlando, dan Syafutra 2021). This opinion is in line with the quote (Sinulingga et al. 2023),This ove could be qural,

as with a sprinter reacting to the starting gun, or visual as with a bour avoiding a punch, a footballer responding to a change in the opposing team's formation, or a cricket batsman reacting to a delivery (Henjilito et al. 2019). Basically, reaction speed is a process that occurs in the body and cannot be seen by the human eye. However, the process can be measured with reaction assays that use optical signals. This opinion is in line with the quote (Ovais Karnain Wadoo 2023) The measurement of visual Reaction time has been used to evaluate the processing speed of Central Nervous System and the coordination between the sensory and motor systems. Reaction time is influenced by different factors. Effect of gender difference on visual reaction time has been observed in this study from study it was concluded that reaction time is less in boys than girls that boys has lesser reaction time than girls. So we can say human visual reaction time is less in males than their female counter part. Continue Reaction time is a determining factor for success in sports competitions (Bilkent, Kahramanmaras, dan Imam 2020). Affirmed by (Bisa 2020) in his journal "Athletes' simple reaction time depends on several variables: type of stimulus; arousal or state of attention, including muscular tension.

Athlete Pencak Silat this need exercise speed reaction because the movements carried out for do attack with quick and precise need speed reaction for anticipate attack from against. During match, punches and kicks released by an oncoming opponent with fast is necessary encouragement action, like parry or dodge from against for attack turning, hitting, and kicking the right target. Involvement in reaction to incoming attack can cause anticipation that is not accurate, so blow or kick taken No perfect or no directed, failed catch limbs opponent and drop, or out of line at times cornered. This is as quoted by (Liu et al. 2023),"it is necessary to look for a physical training model that suits the characteristics of the Silat sport, a dominant element is needed. To know physical needs, it is necessary to observe and observe athletes in competitions."

For practice speed reaction can done with provide a stimulus in the form of hearing, sight and touch to athlete for react. Excitatory hearing can form sound whistle, clap, or other voices. Excitatory vision can form lift hand or cones, throwing the ball towards athlete for arrested or hit. Whereas excitatory touch can done with touch athlete rear order athlete No Can see and hear. exercise speed reaction No can too much, you have to in accordance with condition athlete and the training program applied. If exercise speed reaction to athlete too Excessive, I'm afraid will happen injuries to athletes (Siregar et al. 2021). One of them is method exercise reaction repetitive, involving repeating various type movement with using acoustic signals (hearing), second is method part , which involves change type practice , and third is method sensory, which involves utilise nerve sensory for perceive and distinguish time intervals in one in ten second or one per hundred second (Syafruddin 2013).

A number of factors also influence speed reaction. (Coker 2021) explains that "Influencing factors speed including the mobility process nerves, excitation-termination, contraction-relaxation, stretching muscles, contraction capacity muscles, coordination muscles synergistic and antagonistic, elasticity muscle, strength speed, endurance speed, technique exercise, and power explode". As we know that factors the development with Good in teenage years. In adolescence there are five changes specifically what happened that is, addition rapid height, development sex secondary, development of reproductive organs, changes composition body as well as change system circulation and systems related respiration with body strength and stamina (Jannah 2017). In adolescence, athlete must trained technique precise attacks in order for them can utilise their strength and stamina for achievement.

Optimal performance will be become part most importantly from the training process Pencak Silat besides improve and improve technique less attacks. Control technique attack and speed reaction in match Pencak Silat become provisions for martial artist for follow match and achieve performance best. Reach performance compete optimally will complete series performance in activity exercise as impact exists enhancement use technique attack.

Thus, the overall research results can be concluded that the reaction speed towards increasing the ability of adolescent athletes aged 17-21 years is in the good and sufficient category. Furthermore, this can provide considerations for trainers to increase their strength and reaction speed in carrying out attacks. Apart from that, it is hoped that the results of this research can become a reference for coaches to design attacking techniques and tactics in matches. So that BKMF Pencak Silat UNM youth Pencak Silat athletes can achieve maximum performance in each match.

Conclusion

The results of the researcher's observations while providing reaction speed training given by the trainer, namely 18 meetings carried out at training sessions every week, 3 meetings, namely every Monday, Wednesday and Friday, can improve the sickle kicking ability of Pencak Silat athletes aged 17-21 years and experience a greater increase in motivation, enthusiasm and desire when physical exercise takes place compared to conventional physical exercise.

Conflict of interest

During the development and publication of this work, the authors did not reveal any conflicts of interest.

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