

The effect of the start reaction speed exercise on the increase in acceleration in students of the 2025/2026 academic year.

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Abstract

This study aimed to determine whether there is an effect of start reaction speed training on improving acceleration among Physical Education students (Penjaskesrek) in the 2025/2026 academic year. This research employed an experimental design to examine the effect of start reaction speed training on the acceleration performance of Physical Education students. The research method used was a field experiment. The population, which also served as the research sample, consisted of 10 students. The independent variable was start reaction speed training, implemented through training programs including Up Hill Sprint, Interval Sprint, Hollow Sprint, and Acceleration Sprint. The dependent variable was 30-meter acceleration performance, measured using a 30-meter acceleration test. The instruments used in this study included measurement instruments (test instruments) and treatment instruments (training programs). Based on the results of the study and the statistical analysis of the collected data, it can be concluded that start reaction speed training has a positive effect on improving acceleration among Physical Education students in the 2025/2026 academic year. Therefore, acceleration performance can be enhanced through appropriate start reaction speed training.

Keywords: Start Reaction Speed Training, Acceleration, Physical Education Students

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INTRODUCTION

Athletics is the oldest sport in which there are several physical activities such as running, jumping, throwing and walking. One of the numbers that is often the focus of development is sprint running, which is a short-distance run that demands maximum speed in a short time. In this sport, physical components such as speed and acceleration are very important to achieve the best achievements. For this reason, structured and planned training is needed so that athletes can improve their physical abilities optimally.

A short-distance run, or sprint, is a race number in athletics that involves running 100 meters to 400 meters at maximum speed. Speed in a sprint results from strong, rapid muscle contractions, which are then converted into efficient and smooth movements. Sprints require optimal leg muscle strength and speed, as well as special exercises to improve reaction, strength, muscle strength, agility, and coordination. Sprints are performed at a very fast tempo, where strong muscle contractions are converted into stable and efficient movements, to achieve maximum speed. Overall, short-distance running is an activity that requires

athletes to run as fast as possible along the track from start to finish without reducing speed.

In this condition, it shows the need for an exercise program that specifically emphasizes increasing the speed of the start reaction. This exercise aims to improve coordination between the central nervous system and the leg muscles so that the response to stimuli becomes faster and more effective.

Previous studies have shown that increased reaction speed has a positive correlation with acceleration. According to (Schmidt & Lee, 2011), reaction speed is one of the main factors that determine success in explosive motor activity. Meanwhile, (Bompa, 1999), confirming that exercises that involve rapid responses to external stimuli can increase the effectiveness of the central nervous system in regulating muscle contractions. (Widiastuti, 2015), also states that the shorter an athlete's reaction time, the greater his chances of improving the performance of the acceleration phase in a sprint.

Seeing the importance of the relationship between the start reaction speed and acceleration ability, and there are still acceleration problems that have not been maximized in nursing students. Therefore, it is necessary to conduct research to find out whether the start reaction speed exercise can have a significant influence on increasing acceleration in nursing students for the 2025/2026 academic year.

LITERATURE REVIEW

DescriptionTheoretical

1. The Essence of Sprint Running

Running is defined in sports terms as a movement of the body where at some point all feet do not step on the ground. Short-distance sprinting is often said to be a group of running numbers with very close distances, where participants run at maximum speed along the distance that must be traveled, up to a distance of 400 meters is still classified as sprinting. In the official competition of the International Athletic Amateur Federation (IAAF), the sprint running numbers are classified and included in the competition consist of, distance one hundred meters (100 m), one hundred meters of goal (100 mgw), one hundred ten meters of goal (110 mgw), two hundred meters (200 m), four hundred meters (400 m), four hundred meters of the relay (4x100 m relay), four times the one hundred meter relay (4x100 m relay), and four times four hundred meters of the relay (4x400 m relay). (Dikdik, 2014) states that the sprint running number is one of the numbers in athletics which consists of a running distance of 60 meters to 400 meters. This sprint distance is classified again by (Ballesteros, 1993), into short sprints (100 m, 200 m, 100 mw, 110 mw) and long sprints (400 m and 400 mw).

2. The Essence of Acceleration

1). Definition of Acceleration.

Acceleration in sports is the ability of an athlete to increase speed in a short time from a stationary or slow position to optimal speed. Acceleration is very important in sports that demand speed such as football, athletics, basketball, and so on. According to (Plisk, 2008) acceleration does not only depend on muscle strength, but also on the efficiency of movement techniques, coordination, and initial reaction speed.

2). Acceleration Stages and Techniques

Acceleration is the second phase in sprinting. Acceleration is the average change in speed from the sprinter's step frequency to reach maximum speed in a minimal time. The form of speed caused by a series of body movements in the acceleration phase is acceleration. If the athlete gets the maximum speed within a distance of 70 meters, it means that the athlete accelerates within the distance limit of 20 meters plus 10 meters of the distance of the running reaction speed and the total distance traveled is 100 meters. In addition, if the athlete gains speed within a distance of 60 meters, it means that the athlete accelerates within the distance of 30 meters plus the distance of the running reaction speed, the total distance traveled is 100 meters.

Thus, the limit of acceleration distance for a sprinter is within 20 meters to 30 meters. Maximum speed and maintaining speed (maintenance) are the third phase in a sprint after the acceleration phase. The maximum speed lasts in a distance of 60 meters to 70 meters depending on the acceleration distance performed.

(Fox et al., 1984) acceleration training is a form of exercise that aims to increase speed gradually. This exercise is done by starting movements from low speed such as jogging, then slowly increasing the intensity until it reaches maximum speed. The purpose of this training is to train the muscles of the body to be able to adapt to the increase in speed and improve the ability to accelerate in sports activities, especially in sports that require speed such as short-distance running.

3). Reaction Speed and Acceleration Relationship

Reaction speed and acceleration are very closely related in sprint running performance. Reaction speed acts as the initial trigger of the acceleration process, while acceleration is a continuation of the results of a quick response to the stimulus start. Athletes who have a good reaction speed will be able to start movements earlier and produce stronger initial thrust. Thus accelerating the acceleration phase.

According to (Schmidt & Lee, 2011), reaction speed determines the time it takes to start movement after receiving the stimulus. In sprints, a fast reaction time minimizes the gap between the sound of the gun and the movement out of the starting block, resulting in better initial acceleration. On the other hand, slow reactions cause delays in muscle activation and loss of initial momentum, which directly impacts the acceleration phase. (Bompa & Buzzichelli, 2019), states that reaction speed exercises such as sound starting, reaction sprints, and visual-auditory exercises can improve the efficiency of the central nervous system in responding to stimuli. This has a direct impact on improving acceleration ability. Therefore, a good acceleration training program should include elements of reaction speed training

From the description in the opinion above, acceleration in sports is one of the main components that determine the performance of athletes, especially in sports that demand high speed such as athletics.

3. The Essence of Reaction Time

Reaction speed is a person's ability to respond quickly to stimuli. This stimulus can be in the form of sound (auditory), light (visual), or touch (tactile), which is then responded to with body movements. According to (Bompa 2009) Reaction speed is the time it takes for the neuromuscular system to process stimuli and perform motor responses

4. The Essence of Training

Exercise is a form of processing of training materials that are designed in such a way. Then it is continued with the application or implementation of the training material in the form of exercise movements that are carried out repeatedly, so that the desired training results can be achieved. (Bompa & Buzziehelli, 2019), training is a process that is carried out to improve an athlete's skills, knowledge, and physical condition

5. Start Technique

Star is the initial preparation of a runner to perform a running movement. For short-distance numbers, the start used is a squat start (Crouch Start) while for medium and long distances use a standing start (Standing Start). The main purpose of starting in short distance running, relay/relay running, and goal running is to optimize the speed running pattern. The runner must be able to overcome inertia by applying maximum power to the start block as soon as possible after the start gun or the signal from the starter and moving into an optimal position for the sprint running stage.

RESEARCH METHODS

Place and Time of Research

1. Research time

The research time was held on March 12, 2026 – April 22, 2026

2. Place of execution

Stadion Unpatti

Population and Sample

1. Populasi

Population is the entire object of research, the sampling technique used in this study is purposive sampling. According to (Arikunto Suharsini, 2010) If a person will research all the elements in the research area, it is a population research. The population in this study is 48 male students of the 2025 class A & B.

2. Sample.

The sample in this study is 10 male students from the population to be studied. The sampling technique is by conducting a 100-meter running test, then taken by sequencing the time ranking from the smallest 1 to 10 of the total population of male class A & B students. Then the 10 students with the smallest time will be the research sample

Table 1. Tests
(Arikunto Suharsini, 2010)

Pre-Test	Streatment	Post-test
T1	X	T2

Description:

T1 = Initial test

X = Treatment

T2 = Final Test

Research Variables

The variables in this study consist of two variables, namely X and Y:

1. The independent/independent variable is the start reaction speed exercise denoted by X with the training indicators are: up hill sprint, interval sprint, hollow sprint, acceleration sprint.
2. The bound/dependent variable is a variable denoted by Y with an acceleration test indicator of 30 meters.

E. Research Instruments

In this study, there are two instruments, namely:

1. Instrument Latihan
 - a. Up Hill Sprint
 - 1) Preparation
 - a) Choose a natural incline course (small hills, sloping roads) or treadmill with a 45-degree incline.
 - b) Warm up for 10-15 minutes (light jogging, skiping and bounding).
 - 2) Implementation
 - a) Testi is in the starting position, by doing a squat start (medium start) at the bottom of the ramp.
 - b) Do a 30-meter uphill sprint.
 - c) After reaching the top, the testicle goes down slowly as a recovery.
 - b. Interval Sprint
 - 1) Preparation
 - a) Warming up
 - b) Prepare a training track with a distance of 50 m.
 - 2) Implementation
 - a) Testi stands at the start line.
 - b) On the "yes" signal, the testi ran as fast as possible according to the distance.
 - c) After reaching the finish line, testi istirahat is active (leisurely walk).
 - d) Repeat as per the number of reps.
 - c. Hollow Sprint
 - 1) Preparation
 - a) Warm up.

- b) Prepare a track with distance markings for each phase (50 m sprint, 50 m jogging, and 50 m sprint).
- 2) Implementation
 - a) Testi starts sprinting at a predetermined distance.
 - b) After reaching the mark limit, the test directly transitions to jogging and at the next mark the test directly transitions to sprinting at high speed.
 - c) Maintain good sprint technique during the sprint distance.
 - d) After the sprint is over, return to jogging according to the set set.

d. Acceleration Sprint

- 1) Preparation
 - a) Doing warm-up.
 - b) Prepare a training track with a distance of 30 meters according to the purpose of acceleration training.
 - c) Testi starts from the squat starting position (medium start).
- 2) Implementation
 - a) Testi runs with a gradual increase in speed from the start until he reaches maximum speed at the end of the distance.
 - b) The acceleration phase occurs usually in the first 0-30 meters, with characteristics: the body leans forward at the beginning of the sprint, short and fast steps at the beginning, then gets longer as the speed increases, the arm swings are strong and rhythmic, the push is strong with each step.
 - c) The exercise is carried out without lowering the speed until the finish line of the exercise.

2. Measurement Instruments

The test instrument used by the researcher in this study is a 30-meter acceleration test instrument, in accordance with its purpose, which is to obtain information about the speed of a series of movements and the running speed of athletes, the following are the norms of the 30-meter acceleration test according to (Albertus Fenanlampir, 2015)

Table 2. Norms of Reaction Speed Running 30 meters

NO	NORM	PERFORMANCE (SECONDS)
1	VERY GOOD	3.58 - 3.91
2	GOOD	3.92 – 4.34
3	MEDIUM	4.35 – 4.72
4	LESS	4.73 – 5. 11
5	LESS ONCE	5.12 – 5.50

- 1. Implementation.
 - a. Testi warmed up ready to stand behind the start line. The start used for run 30 was a squat start (Medium star).
 - b. At the "willing" cue, the testator took a squat start stance.
 - c. At the cue of "ready" the tester begins to make preparations for running

- d. At the "yes" cue, the testi began to run as fast as possible until he entered the finish line.

2. Assessment.

- a. The time that can be achieved by the testi in the 30-meter run.
- b. The fastest time achieved in 1 time is the test result.

F. Data Collection Techniques

In this study, the data collection technique was carried out with an initial test in the form of a 30-meter acceleration test, before being given treatment in the form of reaction speed training. After providing treatment for 6 weeks, followed by a final test to determine the effect of reaction speed training on increasing acceleration.

With the test procedure as follows:

- 1. Purpose: to measure acceleration.

2. Equipment:

- a. Field of ramps/ladders of the stands.
- b. Athletic field.
- c. 1 start flag.
- d. 2 sumpritans.
- e. Stationery.
- f. Stopwatch.
- g. Digital camera.

2. Test Officer.

- a. Stater.
- b. Timers.
- c. Timekeeper.
- d. One photographer

3.. Test Implementation Procedure

- a. Testi warmed up ready to stand behind the start line. The start used for run 30 was a squat start (Medium star).
- b. At the "willing" cue, the testator took a squat start stance.
- c. At the sign of "ready", the tester began to prepare to run.
- d. At the "yes" cue, the testi began to run as fast as possible until he entered the finish line.
- e. In this study, what is seen is the time of running within a predetermined distance.

4. Assessment

- a. The time that can be achieved by the testi in the 30-meter run.
- b. The fastest time achieved in 1 time is the test result.

G. Data Analysis Techniques

After the data is collected, it is processed statistically using the t-test that needs to be taken in order to obtain the price of t0 in a row is as follows (Suggestiono, 2012)

$$t0 = \frac{M_D}{SEMD}$$

Description:

to = Initial test

MD = *Mean Of difference* The average value of the calculation of the difference / difference between the score of variable I and the score of Variable II, which can be obtained by formula.

$$M_D = \frac{\sum D}{N}$$

Description:

$\sum D$ = The sum of differences/differences between the scores of variables I (Variable X) and the scores of variables II (Variable Y) and D can be obtained by formula.

$$D = X - Y$$

N = Number of Cases = the number of subjects we researched.

SE_{MD} = Standard error

(Health standards) and *Mean of difference* that can be obtained by formula.

$$SE_{MD} = \frac{SD_D}{\sqrt{N-1}}$$

SD_D = The standard deviation of the difference between variable score I and variable score II, which can be obtained by the formula:

$$SD_D = \sqrt{\frac{\sum D^2}{N} - \left(\frac{\sum D}{N}\right)^2}$$

N = Number of case

Data Description

This study aims to find out how much the effect of the start reaction speed exercise has on the increase in acceleration in nursing students for the 2025/2026 academic year. The data obtained and analyzed in this study include, the initial test data (*Pre-Test*) and the final test (*Post-Test*) from the results of the acceleration increase. After all the data is collected, the data is presented in the following table:

Table 3. Acceleration Test Results.

Name	X	Y	D(X-Y)	D ² (X-Y) ²
IT	4.71	4.61	0,1	0,0
JT	4.98	4.63	0,4	0,1
RS	4.86	4.61	0,3	0,1
GT	4.94	4.58	0,4	0,1
AM	4.71	4.57	0,1	0,0
RL	4.46	4.33	0,1	0,0
FP	4.64	4.44	0,2	0,0
RS	5.21	4.82	0,4	0,2
FL	4.72	4.63	0,1	0,0
RH	4.77	4.60	0,2	0,0
Quantity	$\sum X = 48$	$\sum Y = 46$	$\sum D = 2.2$	$\sum D^2 = 0.6$

Table 4. Frequency Distribution

Value (X)	Frequency	Presentase
5,21	1	10%

4.98	1	10%
4.94	1	10%
4.86	1	10%
4.77	1	10%
4.72	1	10%
4.71	2	20%
4.64	1	10%
4.46	1	10%
Total	N = 10	100%

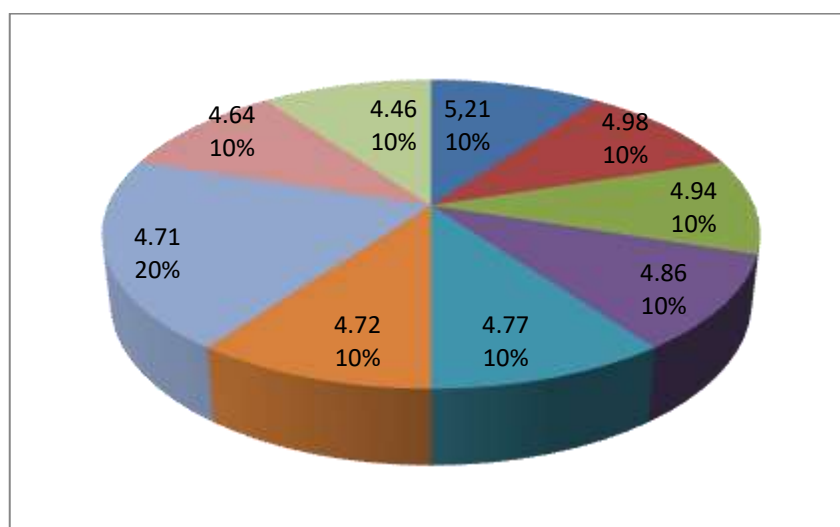


Figure 1 Pie Chart

Based on Table 4 and Figure 1, the results of the frequency distribution of the X niil show that the value of the acceleration increase in the student body is in the range of 4.46 to 5.21. The most common value is 4.71 with a frequency of 2 (20%), while the other values each have a frequency of 1 (10%). The histogram shows that the distribution of data is relatively even, with a tendency to be concentrated at a value of 4.71.

Table 5. Frequency Distribution

Value (X)	Frequency	Presentase
4.82	1	10%
4.63	2	20%
4.61	2	20%
4.60	1	10%
4.58	1	10%
4.57	1	10%
4.44	1	10%
4.33	1	10%
Total	N = 10	100%

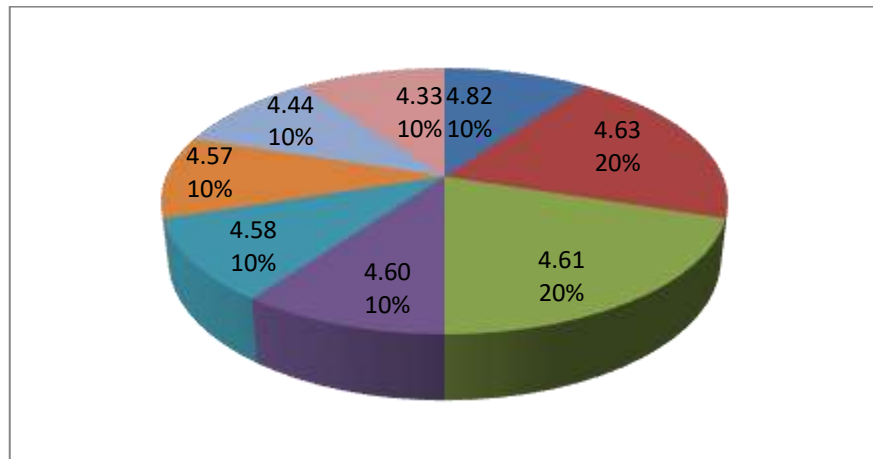


Figure 2. Pie Diagram

Based on Table 5 and Figure 2, the results of the frequency distribution of the Y level show that the value of acceleration increase in students is in the range of 4.33 to 4.82, the most common values are 4.63 and 4.61 with frequency 2 (20%), while the other values each have a frequency of 1 (10%). The histogram shows that the distribution of data is relatively even, with a tendency to be concentrated at values of 4.63 and 4.61.

B. Hypothesis Testing

Finding out whether or not there is an effect of the start reaction speed exercise on increasing acceleration in students for the 2025/2026 academic year is as follows.

1. Research Hypothesis Formula

Ho = There is no influence of variable X on variable Y

Ha = There is an influence of variable X on variable Y

2. Rumus Hypotesis Stats

H0 = $\mu_x = \mu_y$

H1 = $\mu_x \neq \mu_y$

3. Hypothesis Rejection Criteria

Accept H1 if, $t_{\text{calcul}} > t_{\text{table}}$

Subtract H0 if, $\text{count} < t_{\text{table}}$

4. Determining $T\alpha = 0.5 = 1.833$

5. Calculation

Next, the following calculation steps are carried out:

1) Find the mean difference with the formula:

$$\begin{aligned} \text{MD} &= \frac{\sum D}{N} \\ &= \frac{2,18}{10} \\ &= 0,218 \end{aligned}$$

2) Find the standard deviation from the differential (SDD) with the formula:

$$\text{SDD} = \sqrt{\frac{\sum D^2}{N} - \left(\frac{\sum D}{N}\right)^2}$$

$$\begin{aligned}
 &= \sqrt{\frac{0,59}{10} - \frac{(2,18)^2}{10}} \\
 &= \sqrt{\frac{0,059}{10} - (0,048)} \\
 &= 0,107
 \end{aligned}$$

3) Find the standard error of the mean difference with the formula:

$$\begin{aligned}
 SEMD &= \frac{SD_D}{\sqrt{N-1}} \\
 &= \frac{0,107}{\sqrt{10-1}} \\
 &= \frac{0,107}{\sqrt{9}} \\
 &= \frac{0,107}{3} \\
 &= 0,036
 \end{aligned}$$

4) Find t0 by using the formula:

$$\begin{aligned}
 t_0 &= \frac{MD}{SE_{MD}} \\
 &= \frac{0,218}{0,036} \\
 &= 6,100
 \end{aligned}$$

Based on the results of the calculation, it can be seen that the tcount of 6,100 is then consulted with the critical figure of the ttable data at a significant level of 5% or 1% by first determining the db or df where db or df = N-1 = 10-1 =9. For the significant level of 5%, it is known that the ttable value = 1.833. As for the significant level of 1%, it is known that the ttable value = 2.821. That means that both at a significant level of 5% and 1% and can be assessed ttable (5%) <tcalculated> ttable (1%) or in other words 1,833<6,100>2,821. So it can be concluded that there is an effect of the start reaction speed exercise on the increase in acceleration in nursing students for the 2025/2026 academic year.

Based on the hypothesis testing criteria, if $t_{hitung} > t_{tabel}$ the alternative hypothesis is accepted and vice versa is rejected or the hypothesis is Zero. From the above testing, it can be concluded that the alternative hypothesis is accepted and clearly explains that there is an "Effect of Start Reaction Speed Training on Increasing Acceleration in Nursing Students for the 2025/2026 Academic Year". $H_a H_o$

WASHING

Based on the results of hypothesis testing in this study, it is known that there is "The Effect of Start Reaction Speed Training on Increasing Acceleration in Physical Education Students for the 2025/2026 Academic Year". Exercise is a form of repetitive process, not only done once (Marani IN & Miftakhudin H, 2018) quoting from (Harsono, 1998) which states that "Training is a systematic process of practicing or working that is carried out repeatedly by increasing the amount of training or work load day by day". From the form of up hil sprint training, interval sprint, hollow sprint and acceleration sprint, is a form of training from reaction speed to support the acceleration phase in the sprint, from the results of the four training forms of this exercise, it can increase the acceleration speed by 6,100.

However, in this study, the researcher conducted a study using a sample, namely in the 2025 class of sprinters with the aim of proving that the theory that states the forms of training from up hill sprints, interval sprints, hollow sprints and acceleration sprints, can increase the acceleration phase of sprinter athletes or not. It turns out that from the research process, the results obtained show that the above forms of exercise can increase the acceleration speed phase in sprinter athletes. Therefore, this study is a contribution to thinking for coaches to be able to use these forms of training in increasing acceleration speed in sprinter athletes. In proving the effect of exercise on a sample of non-athletes, it can have an effect of 6,100 when compared to the ttable test results greater than the ttable at a significant level of 5% and 1%, it means that real activities are very real to contribute. Acceleration speed in sprinter athletes can be trained using up hill sprint, interval sprint, hollow sprint and acceleration sprint training forms.

This result can be achieved through the planning of an exercise program that is prepared objectively and systematically based on the abilities of Penjaskesrek Students for the 2025/2026 Academic Year with the following explanation:

1. Up Hill Sprint

Up hill running is an exercise that is done on an uphill track such as a hill. Up hill running exercises have the purpose of training the leg muscles to develop dynamic strength, this can be seen from the stimulus provided by the ankle. When running uphill, the extensor muscles in the ankle joint do their heavier task to hold weight, this is influenced by the gravitational force on the uphill trajectory until the muscle fibers enlarge and the number of blood capillaries increases, will result in the quality of muscle contraction increases. With this, it will indirectly make the ankle will get used to the load given from the uphill trajectory. Usually the distance traveled when running up an uphill is around 30-40 meters, this allows for stimulation so that the frequency of steps becomes fast

2. Interval Sprint

Interval sprint is a model of sprint training which in its implementation is interspersed with intervals in the form of istrarest. This exercise is usually done by running as far as 50 meters with a period of 60 meters jogging, with maximum intensity, and 12 repeats.

3. Hollow Sprint

Hollow sprint is a combination of interval sprint training and regular training which is carried out at intervals. According to (Smith, 1990) the implementation of hollow sprint is a 50-meter sprint then interspersed with a 50-meter slow run, then a 50-meter sprint. The purpose of this exercise is to provide adaptation time for the body before receiving the next load.

4. Accelertion Sprint

According to (Fox, 1998), Acceleration sprint is a model that begins with jogging then increases speed and finally runs as fast as possible. The essence of this training is acceleration (speed change) in the form of increasing speed during training. This form of training requires all testers who follow the program to obey the commands imposed by the coach. This training pass also requires each player to be able to control himself, especially in terms of increasing the speed that is always ordered by the coach.

CONCLUSION

This form of exercise can have a very significant influence on increasing the speed of acceleration. This is evidenced by the results of statistical analysis that explains that the calculation is greater than the table at a significant level of 5% or 1%, in the sense that the research hypothesis states that there is "The Effect of Start Reaction Speed

Training on Increasing Acceleration in Physical Education Students for the 2025/2026 Academic Year.

Suggestions

Nursing students can use the results of this study as a reference in understanding the importance of starting reaction speed training to improve sprint running performance.

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