

Research Article**Plyometric Training Methods and Hand Eye Coordination on Volleyball Smash Skills in Sport Education Students, Tadulako University***Andi SAPARIA¹  Firmansyah DLIS²  Achmad Sofyan HANIF³ **Abstract**

This study aims to determine the impact of the plyometric training method and hand eye coordination on the volleyball smash ability in the sports education students Tadulako University. This research method uses an experiment of *treatment by level 2x2* design. The population in this study was 160 students of the sports education study program. Sampling in this study using a randomized group design technique, namely by means of 160 populations randomized and taken 110 samples then tested with the coordination of his hand. This means that in determining this sample of 160 students from a significant level of 5% there are 110 students. The result of this study indicate that: (1) there is a significant difference in influence between from box jump and knee tuck jump to the volleyball smash skill , (2) there is a significant interaction influence between plyometric and hand eye coordination to the volleyball smash skill, (3) there is a significant differences of the smash volleyball skill using a from box jump and knee tuck jump in groups of students with high hand eye coordination, and (4) there is a significant differences of the smash volleyball skill using a from box jump and knee tuck jump in groups of students with low hand eye coordination.

Keywords: Plyometric training method, hand eye coordination, volleyball smash skill

1. INTRODUCTION

Obstacles in sports coaching include weak coordination between sports stakeholders at the national and regional levels as well as low ability, knowledge and skills of sports personnel, weak institutions and management of sports coaching. Firmansyah Dlis said that sport has a natural place in education through formal, non-formal and informal approaches. In physical education schools are a key component of quality education and can be used to promote activities among young people (Dlis, 2015). Coaching is a business activity carried out in an efficient and effective manner in order to obtain better results. Achievement is a result achieved after going through the training process and displayed through the arena of competition. Fostering achievement is an effort or action and activity carried out efficiently and successfully in order to obtain better results achieved after going through the training process and displayed through the arena of competition.

The pattern of sports coaching is one aspect that becomes a facilitator in promoting sports. Therefore, achievement especially in volleyball sports especially smash skills will succeed more optimally if supported from all the physical elements involved in it (Saparia, 2011: 98). Sports development is carried out through the formation and development of the working relationships of the parties involved in harmony, openness, reciprocity, synergy, and mutual benefit (Bobi, 2015).

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The principles that must become a necessity in fostering and transparency and accountability are directed to encourage the availability of accessible information so as to provide an opportunity for all parties to participate in sports activities, enable all parties to participate in sports activities, enable all parties to carry out their obligations optimally and with certainty to obtain their rights, and allow the operation of control mechanisms to avoid flexible and comprehensive national deficiencies.

Coordination is a person's ability to integrate different movements into an effective single movement pattern. So that coordination is the body's ability to assemble or combine several elements of movement into an effective and harmonious movement in accordance with the objectives. Bompa (2009) suggested that eye-hand coordination will produce timings and accuracy. Timing is oriented on punctuality while accuracy is oriented on target accuracy. Through good timing, the wearing of hands and objects (Manuel, Lima, & Nikolaidis, 2016) will be in accordance with the wishes in this case the wearing of hands on the ball, so that it will produce an effective movement. Accuracy will determine the exact and whether the object at the intended target in this case the accuracy of the direction and placement of the ball on the target. Therefore eye-hand coordination is very important in the ability to do a smash so that the smash can be precisely on the desired target.

Volleyball especially smash skills can be used as a means to educate, because with volleyball, sports can form a sportive, honest person, cooperation, responsibility, all of which are educational values that can be instilled, therefore the volleyball smash skill game it is a must to be programmed in the curriculum that is now used in every tertiary institution. Mastery of the basic techniques of perfect smash skills is the basis for developing the achievements of the game itself (Engetou, 2017). Mastery of the basic techniques of smash skills in volleyball is one of the elements that determine the victory or defeat of a team. The application of appropriate training methods in the process of training the basic techniques of volleyball smash skills. His findings will provide opportunities for trainers to make the most of available facilities (Klentrou, 2015). So there is no reason for the volleyball smash skills coach because the obstruction of the practice of volleyball smash skills is a factor in the inadequacy of the volleyball smash skill facility available at volleyball clubs. The selection and application of methods in training the basic technical skills of volleyball smash skills for students of the Sport Education Program Tadulako University in Palu, so that the methods applied are able to improve the results of training in mastering smash skills, then in this study two types of methods will be applied in the game training patterns. Volleyball smash skills are training methods that include plyometric exercises, and hand eye coordination is also applied. However, this article will only discuss knee tuck jump plyometric training methods and high hand eye coordination.

The plyometric training method is an exercise method that can be used to improve the bio motoric freshness of athletes, including strength and speed which has a very wide application in sports activities, and in particular this exercise is very useful for increasing power. Some forms of plyometric exercises that can be used to increase the explosive power of the lower limbs are bounds, hops, jumps, leaps, skips, ricochets, jumping-in places. Standing jumps, multiple hops and jumps, box drills, bounding, and knee tuck jumps (Radcliffe and Farentinos, 1985). Within the scope of physical education, one of which is the formation of motion, which includes the desire to move, to live in time and form including the feeling of rhythm. Motor development is very closely related to physical activity. Motoric is the development of controlling body movements through a coordinated activities between the nervous system, brain, and spinal cord (Tangkudung, 2018).

The training method that will be applied can be well design, the pattern of movement in plyometric exercises mostly follows the concept of power chain and most exercises, specifically involving the muscles of the lower limbs, because the movement of these muscle groups is clearly the center power. In principle, plyometric exercises are based on the principle of pre-stretching the muscles involved during the completion stage of the response or shock absorption from the tension exercised by the muscles while working.

Plyometric training is also called stretch reflexes or regular muscle reflexes combined with the sprinting, which is running and suddenly running as fast as possible to the front (Radcliffe & Farentinos, 1985). Plyometric exercises can be done with a prefix or without a prefix, with one repulsion leg or two repulsion legs (Sneyer, 1988). This repulsion uses deep jumps that can maximize plyometric so that the training objectives are more optimal. Jensen & Russell (2013) explained in their quote that execute a depth jump means to drop from some specified height and upon landing immediately spring into a maximum vertical jump.

Plyometric method use gravity to store energy in muscles and immediately release opposing energy (Thomas & Nelson, 2001). The concept of plyometric exercises uses an initial stretch in the muscle quickly before eccentric contractions in the same muscle. Radcliffe and Farentinos divide three groups of plyometric exercises, namely: (1) exercises for lower limbs (hips and legs), (2) exercises for the torso, and (3) exercises for upper limbs (Radcliffe & Farentinos, 1985). Plyometric is one of the favorite training performed by trainers at this time, especially for sports that require explosive power of leg muscles or arm muscles (Lubis, 2005). Another term for plyometric training is stretch shortening cycle (Ngurah, 1998). Referring to some of the definitions above, it can be concluded that plyometric training is a form or method of training to increase muscle power with a combination of isometric and isotonic exercises that use the body's own burden. Strains that occur suddenly before the muscles to contract again or a training that allows the muscles to reach maximum strength (Marynowski, 2013).

Front box jump training is one of plyometric training. Front box jump is the practice of jumping up to the box, then jumping back down to the front like the initial attitude by using both legs together (Chu, 1992). Front box jump exercises require a specified intensity, so this movement should be done by jumping not by stepping on a box or box, in addition to height and the process of increasing pressure when landing. Height control and control the ability to jump above the box. M. Furqon and Muchsin Doeswes also explained that knee tuck meet was an exercise that was carried out on a flat and rushed surface such as grass, a mat, or a mat. This exercise is done in a fast explosive leap (Furqon & Doeswes, 2002). Based on the opinion above, it can be interpreted that the plyometric training method is a form of training in improving volleyball smash skills. Central Sulawesi Province is a province that has potential in the field of sports in the eastern region. But the pattern of coaching in the field of sports is still too far from what is expected by the government, due to the still thick culture that has so that it affects the existing life and sports human resources that are still lacking.

This must start from the coaching pattern Tadulako University which has a Sports Education study program with students from various regions in Central Sulawesi with young talents in volleyball. The pattern of sports training for volleyball smash skills in Central Sulawesi, especially in of Physical Education students in Tadulako University, is quite good but there is still a need to improve, especially the system of sports training methods that involve sports science and technology in coaching. The synergy between human resources and involving sports coaching technology will bring a more efficient and effective feel to advance the sport of the volleyball smash skills in Central Sulawesi.

Achievement of coaching that has not been maximized in volleyball in Central Sulawesi, especially in students of Tadulako University's sports education in Palu due to facilities and infrastructure factors and the pattern of coaching has not been of good quality and the supporting factors for increasing sports coaching are inadequate. This is what needs to be studied and explored through this research, so that later it will provide an overview and contribution of thoughts about the method of plyometric training and eye hand coordination.

2. METHOD

2.1 Research Design

The research method used is the experimental method with the design of treatment by level 2 x 2. According to Sudjana that factorial experiments are experiments that almost or all levels of a factor are combined or crossed with all the levels of each of the other factors that exist in an experiment (Sudjana, 2002).

2.2 Sample

The population in this study came from sports education study program students department of education Tadulako University, Palu, with 160 people consisting of 4 classes, each class consisting of 40 students. While the sampling in this study was carried out by randomized group design technique, namely by means of 160 populations randomized and 110 samples taken and then tested with the coordination of his hand. This means that in determining this sample of 160 students from a significant level of 5% there are 110 students.

2.3 Data Collection and Data Analysis

Data collection is carried out to obtain empirical data as material to test the truth of hypotheses. In this study, data that must be collected using tests and measurements is data about:

- Pliometric training methods which include Front box jump exercises and Knee tuck jump exercises
- Hand eye coordination
- Smash skills in volleyball game. Researchers need test staff who will help come from fellow lecturers so that the results of data collection are more accurate as a result of research.

2.4. Data Analysis

The data analysis techniques used in this study are prerequisite tests using liliefors test and Bartlet test, while for hypotheses to test using ANOVA and Tukey test.

3. FINDINGS

3.1. Normality and Homogeneity Test Results

Normality and homogeneity tests are prerequisites before testing hypotheses. For the normality test was using the Liliefors test, while for the homogeneity test was using the Bartlet test.

3.1.1. Normality test

From the results of the Liliefors test conducted at the smash ability level, the following results are obtained:

Table 1. Normality test results

Group	Sample	$L_{count} (L_0)$	$L_{table} (\alpha=0,05)$	Info
A_1	20	0,121	0,190	Normal
A_2	20	0,094	0,190	Normal
A_1B_1	10	0,176	0,258	Normal
A_2B_1	10	0,220	0,258	Normal
A_1B_2	10	0,198	0,258	Normal
A_2B_2	10	0,102	0,258	Normal

Based on Table 1 it can be seen that overall test results are significant with $L_{count} > L_{table}$, so the population is normally distributed.

3.1.2. Homogeneity Test

In the testing of homogeneity with Test Bartlet data level smash skills on the four group exercise methods plyometric students study Program Sports Education Department of Science

Education Tadulako City Palu acquired value Bartlett $\chi^2_{count} = 5.297$ and $X^2_{tab} = 16.91$ and smaller than the value of $\alpha = 0.05$ or at a rate of 95%. Thus, the four Data group has the same variance or score from to 4 groups is homogeneous.

Table 2. Homogeneity test result

Sampel	N	Db	1/db	si2	log si	db.log(si2)
A ₁ B ₁	10	9	0,11	8,61	0,935059	8,415532738
A ₂ B ₁	10	9	0,11	8,25	0,916454	8,248085537
A ₁ B ₂	10	9	0,11	23,28	1,366942	12,30247366
A ₂ B ₂	10	9	0,11	6,94	0,841638	7,574737571

3.2. Hypothesis Test Results

Differences in From Fox Jump and Knee Tuck Jump Method on Volleyball Smash Skill

Table 3. Analysis A₁ – A₂

Plyometric Method (A)	Plyometric Method (A)	Mean Difference	Std. Error	Sig.
A1	A2	3,19	13,995	,002

This hypothesis is accepted after it is obtained through the results of data calculations, the results of Tukey Test analysis are obtained $Q_{OA} 3.19 > Q_{(tab)} 2.86$ or H_0 is rejected. There is a significant difference sig (p) is 0.021 ($0.021 < 0.05$), to be seen in the column table Sig (p) is 0.021 or the probability above $\alpha = 0.05$. So the decision can be taken to reject H_0 and accept H_1 . there is a difference in the average smash skills of the groups who were given the Front box jump training method and the Knee tuck jump training method in the Department of Sport Education Students in Tadulako University. Thus the method of Front box jump training is higher than the Knee tuck jump training method.

The interaction between the Plyometric Method and Hand Eye Coordination

Based on a summary of the results of the analysis of variance analysis, the value of F-interaction interaction $F_{(OAB)} = 1.750$ was obtained with p-value = $0.007 < 0.05$ or H_0 was rejected. Thus there is a very significant interaction effect between plyometric training methods (Factor A) and hand eye coordination (factor B) on smash skills in volleyball. Thus the research hypothesis states that there is an interaction between plyometric training methods and hand eye coordination to the level of smash skills tested.

Difference in From Box Jump and Knee Tuck Jump Method with High Hand Eye Coordination

Table 4. Analysis of A₁B₁ – A₂B₁ groups

Group (B1)	Group B1)	Mean Difference	Std. Error	Sig.
A ₁ B ₁	A ₂ B ₁	5,50	13,995	0,02

This hypothesis was accepted after it was obtained through the results of data calculations, the results of the Tukey Test analysis obtained that the Q_{count} was $5.50 > Q_{table} 2.95$, this meant that H_0 was rejected and H_1 was accepted. There is a significant difference sig (p) is 0.020 ($0.020 < 0.05$), to be seen in the column table Sig (p) is 0.020 or the probability is far below $\alpha = 0.05$. So the decision can be taken to reject H_0 and accept H_1 . Thus it can be concluded that the volleyball smash skills taught by the Front Box Jump (A_1) Plyometric training method are lower than the Knee tuck jump (A_2) plyometric training method in groups that have low hand eye coordination (B_2).

Difference in From Box Jump and Knee Tuck Jump Method with Low Hand Eye Cordination

Table. 5. Analysis of $A_1B_2 - A_2B_2$ groups

Group (B1)	Group B1)	Mean Difference	Std. Error	Sig.
A_1B_2	A_2B_2	4,71	13,995	0,008

This hypothesis is accepted after it is obtained through the results of data calculation, the Tukey Test analysis results obtained that the Q_{count} is $4.71 > Q_{table} 2.95$, this means that H_0 is rejected and H_1 is accepted. There is a significant difference sig (p) is 0.008 ($0.008 < 0.05$), to be seen in the column table Sig (p) is 0.008 or the probability is far below $\alpha = 0.05$. So the decision can be taken to reject H_0 and accept H_1 . Thus it can be concluded that the volleyball smash skill between the plyometric Front box jump training methods is higher than the plyometric Knee tuck jump training method in groups that have low hand eye coordination

4. DISCUSSION and CONCLUSION

The purpose of this study is to find differences and interactions of plyometric method and hand eye coordination in skills of smash on Volleyball. The following discussion is as follows:

Differences in From Fox Jump and Knee Tuck Jump Method on Volleyball Smash Skill

There is a difference in the average smash skills of the groups who were given the Front box jump training method and the Knee tuck jump training method in the Department of Sport Education Students Tadulako University. The plyometric training method is a form of Explosive Power exercise with the characteristics of using muscle contractions that are very strong and fast, the muscles always contract both when elongated (Eccentric) or when shortened (Concentric) in a fast time, so that during work the muscles there is no time for relaxation. Plyometric refer to exercises that are characterized by strong muscle contractions in response to rapid and dynamic loading or stretching of the muscles involved. Muscle speed when elongating and shortening affects the energy produced so that this training is really needed in improving the volleyball smash skills that rely on the elements of speed and strength (power).

As we know, plyometric methods include Front box jump and knee tuck jump which both have the same goal, namely to increase muscle strength. Front box jump is the practice of jumping up to the box, then jumping back down to the front between the box as the initial attitude by using both legs together then jumping to the next box in the lower box and so on. While Knee tuck jump is a form of exercise that is done by jumping up repeatedly while the body is in the air, knees bent until it touches the chest and ends in posture as before. This knee tuck jump exercise relies more on maximum jump strength, flexibility and balance and is more significant on the smash movement patterns in volleyball games.

Based on the treatment of the plyometric training method, students who were given the Front box jump training method were better compared to the Knee tuck jump training method in improving the volleyball smash skills. Thus, it can be concluded that the level of volleyball smash skills in the group method of front box jump training. Students of the Educational Study Program of Sport

Education Tadulako University, can be said to have a significant effect compared to the Knee tuck jump training method.

The interaction between the Plyometric Method and Hand Eye Coordination

There is a significant difference between plyometric method and hand eye coordination on Smash Volleyball students. The method of training is a continuous and systematic process of practicing or working that is done repeatedly with increasing day by day increasing workloads aimed at improving the appearance of athletes in training and in competition. Training becomes very effective and efficient if done with a good program and adapted to the dominant training component of a particular sport. The ability factor in volleyball athletes is very much needed and can be improved through training. One model of training to improve athlete's stamina is to use a structured training model that can have a positive impact on the athlete being trained. The right training method is a training system that can develop simultaneously so that the physical components can change quickly.

The selection of appropriate and suitable training methods according to the needs of athletes and specific sports is the responsibility of a trainer. The trainer must be able to determine the training methods that are appropriate and relevant to the training objectives such as the plyometric training method of pyramiding box jump, front box jump and knee tuck jump which are considered in improving smash skills in volleyball games. Besides the characteristics of athletes in improving volleyball smash skills can also be a basic reference in selecting athletes according to certain sports such as volleyball which in its implementation is almost the game's elongation is determined by hand movements such as hand accuracy and hand strength etc.

Hand eye coordination is an aspect that must be possessed by a volleyball athlete, especially in making a smash. Eye-hand coordination of smash skills is a very important component because eye-hand coordination is a form of ability and speed as well as accuracy in conducting smash skills including motion coordination that can change positions as quickly as possible to achieve maximum smash blows. Eye-hand coordination is a motor skill that is very complex in demonstrating steady patterns of motion so it can be assumed that eye-hand coordination affects smash skills in volleyball. This can be proven by the important role of coordination in making every body movement in volleyball smash even the coordination of other body parts also has a role in the basic technique of volleyball game. Hand eye coordination provides a very complex influence in supporting the performance of volleyball smash skills. Thus the research hypothesis states that there is an interaction between plyometric training methods and hand eye coordination to the level of smash skills tested.

Difference in From Box Jump and Knee Tuck Jump Method with High Hand Eye Coordination

There is a significant difference in the value of volleyball smash skills between groups of students who use the Front box jump training method and groups of students who use the Knee tuck jump training method and the volleyball smash skill scores of groups of students trained with plyometric training methods more Knee tuck jump superior or high than the value of groups that are trained by the method of front box jump training on students.

The method of training and eye hand coordination is a training method that involves all physical elements. As we know, plyometric training methods include Front box jump exercises and knee tuck jump exercises that both have the same goal of increasing muscle strength. Front box jump exercises are exercises to jump up to the top of the box, then jump back down to the front between the boxes as the initial attitude by using both legs together then jumping to the next box in the lower box and so on. While Knee tuck jump is a form of exercise that is done by jumping up repeatedly while the body is in the air, knees bent until it touches the chest and ends in posture as before. This knee tuck jump exercise relies more on maximum jump strength, flexibility and balance and is more significant on the pattern of smash movements in volleyball than with the Pyramiding box jump exercise which prioritizes leg strength to maximize jumps. While eye-hand coordination which is a form of

coordination that involves elements of strength and accuracy in making smash punches involving body components, especially in the upper body.

The physical component that is very instrumental is the arm that must have strength with good coordination, so as to produce maximum smash skills. A volleyball player with good hand eye coordination is not only able to perform smash skills but is also able to perform techniques perfectly. The ability to coordinate good motion can change and move quickly from one pattern of motion to another pattern of movement so that the movements can be done efficiently and not drain more energy. Thus based on the results of the study, it can be concluded that the Knee tuck jump training method of the high hand eye coordination group is better than the Front box jump training method in the high hand eye coordination group in an effort to improve smash skills in volleyball games.

Difference in From Box Jump and Knee Tuck Jump Method with Low Hand Eye Coordination

There is a significant difference in the value of volleyball smash skills between groups of students who use the Front box jump training method and groups of students who use the Knee tuck jump training method and the volleyball smash skill scores of groups of students trained with plyometric training methods more superior / high Front box jumps than the value of groups that are trained by the Knee tuck jump training method on students. The final goal that an athlete wants to achieve in a sport is a high achievement. High achievements are difficult and even impossible to obtain if the training process is not serious. In addition, supporting factors to achieve high achievement also include trainers who have broad insights so as to provide training methods and treat their students properly and appropriately. One of the training methods that can be used specifically for volleyball smash exercises is the plyometric training method including Front box jump and knee tuck jump exercises.

Plyometric training methods include Front box jump exercises and knee tuck jump exercises that both have the same goal of increasing muscle strength. Front box jump is the practice of jumping up to the box, then jumping back down to the front between the box as the initial attitude by using both legs together then jumping to the next box in the lower box and so on. While Knee tuck jump is a form of exercise that is done by jumping up repeatedly while the body is in the air, knees bent until it touches the chest and ends in posture as before. This knee tuck jump exercise relies more on maximum jump strength, flexibility and balance and is more significant on the pattern of smash movements in volleyball games compared to Pyramiding box jump exercises that prioritize leg strength to maximize jumps.

Besides that the success factor of athletes or students in volleyball games especially smash training is also greatly supported in terms of eye-hand coordination which is a form of coordination that involves elements of strength and accuracy in making smash punches involving body components especially in the upper body. A very important physical component is the arm that must have strength with good coordination, so as to produce maximum smash skills. A volleyball player with good eye hand coordination is not only able to perform smash skills but also able to perform techniques perfectly. The ability to coordinate good motion can change and move quickly from one pattern of motion to another pattern so that the movement can be done efficiently and does not drain more energy and vice versa if hand eye coordination is low it will experience smash training well, fast and efficient.

Thus based on the results of the study, it can be concluded that the method of Front box jump training is better than the Knee tuck jump training method in the low hand eye coordination group in an effort to improve smash skills in volleyball games.

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