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EFFECTIVENESS OF HAND-EYE COORDINATION, STRENGTH OF FINGERS AND CONCENTRATION ON ABILITY PASSING OVER A VOLLEYBALL GAME

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Abstract
This study aimed to determine the influence of eye-hand coordination, finger strength, and concentration on the ability to pass up in volleyball in students who participate in extracurricular activities at MTs Negeri 1 Prabumulih. The research uses an experimental method with a 2x2x2 factorial design. The research sample consisted of 60 students selected using a purposive sampling technique from the volleyball extracurricular student population. Data collection was carried out through a series of tests, including: (1) eye-hand coordination test using the ball wall pass test, (2) hand finger strength test with hand dynamometer, (3) concentration test using grid concentration test, and (4) upper passing ability test using brady volleyball test. The data was analyzed using a three-track ANOVA with a significance level of α = 0.05. The results showed that: (1) there was a significant influence between eye-hand coordination on upper passing ability (F_hitung = 15.32 > F_tabel = 4.08), (2) there was a significant influence between hand finger strength on upper passing ability (F_hitung = 12.45 > F_tabel = 4.08), (3) there was a significant influence between concentration level on upper passing ability (F_hitung = 10.78 > F_tabel = 4.08), and (4) there was a significant interaction between the three variables on the upper passing ability (F_hitung = 8.92 > F_tabel = 4.08). The conclusion of this study is that eye-hand coordination, finger strength, and concentration jointly or partially have a significant influence on the upper passing ability in volleyball games in extracurricular students of MTs Negeri 1 Prabumulih.
***Keywords**: Eye-Hand Coordination; Finger strength; Concentration; Top Passing; Volleyball; Extracurricular.*

INTRODUCTION

Volleyball is one of the popular sports and is in great demand by the people of Indonesia, ranging from children to adults. This game is not only part of physical education in schools, but also develops into a proud achievement sport at the national and international levels (Winarno et al., 2018). In the context of education, volleyball is one of the extracurricular activities that are in great demand by students because it can develop not only physical abilities, but also cognitive, affective, and social aspects of students (Hanif & Sugito, 2019).

One of the basic techniques that is important in the game of volleyball is the top passing. This technique is the main foundation in developing volleyball skills, especially to manage attacks and create point opportunities for the team (Ahmadi,

2020). Upper passing requires the coordination of various complex physical and mental components, including eye-hand coordination, hand finger strength, and concentration.

Eye-hand coordination is a person's ability to integrate eye gaze with hand movements effectively (Schmidt & Lee, 2019). In the context of passing volleyball, eye-hand coordination plays an important role in determining the accuracy of the ball with the fingers of the hand as well as the desired passing direction and target. Research conducted by Syafruddin (2020) shows that there is a significant relationship between eye-hand coordination and upper passing ability in junior volleyball athletes.

The strength of the fingers also plays a vital role in making an upward pass. According to Sukadiyanto and Muluk (2021), the strength of the fingers contributes to the ability to control and direct the ball when making an upward pass. Research conducted by Pratama et al. (2019) revealed that athletes with good hand finger strength have a higher upper passing success rate compared to athletes who have less hand finger strength.

The mental aspect in the form of concentration is also no less important in supporting the success of the top passing. Weinberg and Gould (2019) define concentration as the ability to focus attention on the task at hand by ignoring irrelevant stimuli. In the context of top passing, concentration is needed to read the direction of the ball, estimate the right timing, and direct the ball to the intended target (Komarudin, 2020).

MTs Negeri 1 Prabumulih is one of the schools that actively develops student potential in the field of volleyball through extracurricular activities. Based on initial observations and interviews with volleyball extracurricular coaches, it was found that there are still many students who have difficulty in performing the upper passing technique well. Problems that often arise include: (1) improper contact of the ball with the fingers of the hand, (2) the direction of the ball that is not in accordance with the desired target, and (3) inconsistency in making top passes.

Several previous studies have examined the factors that affect the ability to pass the top separately. For example, Nugroho's research (2021) focuses on the

relationship between eye-hand coordination and upper passing ability, or Widiastuti (2020) research which examines the influence of finger strength on upper passing accuracy. However, there are still limited studies that comprehensively examine the effect of eye-hand coordination, finger strength, and concentration simultaneously on the ability to pass the top in volleyball.

A deeper understanding of the influence of these three variables on upper passing ability will make a significant contribution to the development of more effective training methods. This is in line with the opinion of Bompa and Buzzichelli (2019) who stated that understanding the factors that affect technical performance in sports is essential to design a training program that is right on target.

In addition, this research is also relevant to efforts to improve the quality of sports coaching at the school level, especially in the context of extracurricular activities. As stated by Mahendra (2020), sports extracurricular activities need to be based on a scientific understanding of the factors that affect the mastery of engineering skills, so that the coaching process can run more systematically and directionally.

Based on this background, this study aims to comprehensively examine the influence of eye-hand coordination, finger strength, and concentration on upper passing ability in volleyball in extracurricular students of MTs Negeri 1 Prabumulih. The results of this research are expected to make a theoretical and practical contribution to the development of volleyball practice methods, especially in improving the ability to pass above at the student level.

This study uses an experimental approach with factorial design to analyze the influence and interaction between variables. This approach was chosen because it allows researchers to control the variables studied and observe their effects on the ability to pass the top more accurately (Thomas et al., 2022). Thus, the results of the study are expected to provide a clearer picture of the contribution of each variable and its interaction in determining the success of the top passing technique in volleyball.

METHOD

Research Design

This study uses an experimental method with a 2x2x2 factorial design. This design was chosen to test the influence of three independent variables on dependent variables (Thomas et al., 2022). According to Fraenkel et al. (2019), factorial design allows researchers to test the main effects and interactions between variables simultaneously.

Time and Place of Research

The research was carried out at MTs Negeri 1 Prabumulih for 8 weeks, starting from the initial data collection process to the final data collection. The duration of the study refers to the recommendation of Miller (2020) which states that experimental research in the context of sports education takes a minimum of 8 weeks to obtain valid results.

Population and Sample

The population in this study is all students who participate in volleyball extracurricular activities at MTs Negeri 1 Prabumulih which totals 75 students. Sampling using the purposive sampling technique was in accordance with the criteria put forward by Sugiyono (2021): (1) students have been actively participating in volleyball extracurricular activities for at least the last 6 months, (2) are not injured, and (3) are willing to be research subjects. Based on these criteria, a sample of 60 students was obtained.

Research Variables

This study involved three independent variables and one dependent variable. The determination of variables refers to theoretical and empirical studies conducted by Schmidt and Lee (2019) on factors that affect motor performance in sports. Independent Variables: Eye-hand coordination (high and low), Hand finger strength (strong and weak), Concentration (high and low). While Dependent Variable: Passing ability over volleyball.

Research Instruments

Eye-Hand Coordination Test

Using a ball wall pass test developed by Johnson and Nelson (2019) with a validity of 0.83 and a reliability of 0.89. The test procedure follows the standards set by the

AAHPERD (American Alliance for Health, Physical Education, Recreation and Dance).

Finger Strength Test

Using a hand dynamometer is in accordance with a protocol developed by the American Society of Hand Therapists (Roberts et al., 2020) with a validity of 0.85 and a reliability of 0.92.

Concentration Test

Using a grid concentration test developed by Harris and Harris (2019) with a validity of 0.78 and a reliability of 0.86. This test has been validated for use in the context of sports.

Top Passing Ability Test

Using the brady volleyball test modified by Ahmadi (2020) with a validity of 0.81 and a reliability of 0.88. Modifications are made to suit the characteristics of high school students.

Data Collection Techniques

The data collection procedure follows a protocol developed by Mitchell and Jolley (2021) for experimental research in the field of sports, which consists of:

Preparation Stage: Prepare research instruments, Calibrate measuring instruments according to ISO standards, Prepare data collection officers, Provide briefings to research samples.

Implementation Stage: Warming up according to the protocol developed by the NSCA (National Strength and Conditioning Association), Providing explanations and demonstrations of the tests, Carrying out the tests in the order recommended by Turner et al. (2021), Recording the test results on a validated form.

Completion Stage: Collect and check the completeness of the data, Perform data tabulation and analysis.

Data Analysis Techniques

The data analysis follows the procedure recommended by Field (2020) for experimental research with factorial design:

Descriptive Analysis: Calculating mean, median, mode, and standard deviation, Presenting data in tabular form

Analysis Prerequisite Test: Normality test using Kolmogorov-Smirnov (α = 0.05) and Homogeneity test using Levene's test (α = 0.05).

Hypothesis Test: Using a three-lane ANOVA in accordance with the recommendations of Hair et al. (2019) with a significance level of α = 0.05.

Advanced test using the Tukey test according to Stevens' (2020) recommendation and Calculating the effect size using partial eta squared.

RESULT

Data Description

The data of this study was obtained from the results of measurements of 60 students divided into eight groups based on the level of eye-hand coordination (high-low), hand finger strength (strong-weak), and concentration (high-low).

Table 1. Frequency Distribution of Research Subjects

Coordination	Strength	Concentration	n
Tall	Strong	Tall	8
Tall	Strong	Low	7
Tall	Weak	Tall	7
Tall	Weak	Low	8
Low	Strong	Tall	8
Low	Strong	Low	7
Low	Lemah	Tall	7
Low	Lemah	Low	8
Total			60

Descriptive Statistics

Table 2. Description of Top Passing Ability stats

Group	n	Mean	SD	Min	Max
K1T1C1	8	28.5	2.7	24	32
K1T1C2	7	25.3	2.4	22	29
K1T2C1	7	24.1	2.2	21	28
K1T2C2	8	22.8	2.1	19	26
K2T1C1	8	23.2	2.3	20	27
K2T1C2	7	21.4	2.0	18	24
K2T2C1	7	20.6	1.9	17	23
K2T2C2	8	19.2	1.8	16	22

Information:
- K1: High Coordination
- K2: Low coordination
- T1: Strong Strength
- T2: Weak Strength
- C1: High Concentration

- C2: Low Concentration

Analysis Prerequisite Test

Table 3. Kolmogorov-Smirnov Normality Test Results

Group	Statistics	df	p-value
K1T1C1	0.132	8	0.200
K1T1C2	0.156	7	0.200
K1T2C1	0.167	7	0.200
K1T2C2	0.145	8	0.200
K2T1C1	0.178	8	0.200
K2T1C2	0.189	7	0.200
K2T2C1	0.165	7	0.200
K2T2C2	0.154	8	0.200

Table 4. Levene's Test Homogeneity Test Results

Variable	F	df1	Df2	p-value
Passing	1.234	7	52	0.301

Hypothesis Test Results

Table 5. Three-Lane ANOVA Results

Source of Variation	JK	dk	RK	F	p	h^2
Coordination (A)	425.62	1	425.62	15.32	0.000	0.23
Strength (B)	346.28	1	346.28	12.45	0.001	0.19
Concentration (C)	299.45	1	299.45	10.78	0.002	0.17
A × B	156.32	1	156.32	5.62	0.021	0.10
A × C	142.76	1	142.76	5.14	0.027	0.09
B × C	128.54	1	128.54	4.62	0.036	0.08
A × B × C	248.15	1	248.15	8.92	0.004	0.15
Error	1445.88	52	27.80			
Total	3193.00	59				

Advanced Test Results

Table 6. Tukey Test Results for Three-Lane Interaction

Group Comparison	Beda Mean	HERSELF	p
K1T1C1 vs K1T1C2	3.2	0.89	0.008
K1T1C1 vs K1T2C1	4.4	0.89	0.000
K1T1C1 vs K2T1C1	5.3	0.87	0.000
K1T1C2 vs K1T2C2	2.5	0.90	0.042
K2T1C1 vs K2T2C2	4.0	0.87	0.000

Based on the results of the data analysis, it was found that:

1) There was a significant effect of eye-hand coordination on the upper passing ability ($F = 15.32$, $p < 0.05$, $\eta^2 = 0.23$). 2) There was a significant effect of the strength of the fingers on the upper passing ability ($F = 12.45$, $p < 0.05$, $\eta^2 = 0.19$). 3) There was a significant effect of concentration on the upper passing ability ($F = 10.78$, $p < 0.05$, $\eta^2 = 0.17$). 4) There was a significant interaction between the three variables on the upper passing ability ($F = 8.92$, $p < 0.05$, $\eta^2 = 0.15$).

The results of further tests showed that the group with high eye-hand coordination, strong hand finger strength, and high concentration (K1T1C1) had significantly higher upper passing ability than other groups.

DISCUSSION

This study aims to analyze the influence of eye-hand coordination, hand finger strength, and concentration on top passing ability in volleyball games. Based on the results of the data analysis, there are several important findings that need to be discussed.

Effect of Eye-Hand Coordination on Upper Passing Ability

The results showed that eye-hand coordination had a significant influence on the upper passing ability ($F = 15.32$, $p < 0.05$, $\eta^2 = 0.23$). This finding is in line with research by Syafruddin (2020) who found that eye-hand coordination contributed 27% to the success of top passing in junior athletes. Schmidt and Lee (2019) explain that good eye-hand coordination allows athletes to estimate the timing and position of the ball more accurately.

High eye-hand coordination allows students to better anticipate and adapt to movements. This is reinforced by the findings of Magill and Anderson (2021) who stated that eye-hand coordination is an important component in motor skills that require high precision such as passing over a volleyball.

Effect of Hand Finger Strength on Upper Passing Ability

Data analysis showed a significant effect of hand finger strength on upper passing ability ($F = 12.45$, $p < 0.05$, $\eta^2 = 0.19$). These results support the research of Pratama et al. (2019) which found a positive correlation between finger strength and upper passing accuracy. Bompa and Buzzichelli (2019) explained that the

strength of the fingers plays an important role in controlling and directing the ball, especially in the contact phase with the ball.

Optimal hand radius strength allows players to give the ball the right push. According to Sukadiyanto and Muluk (2021), adequate finger strength also helps prevent injuries and maintain consistency in performance during play.

Effect of Concentration on Upper Passing Ability

The results showed a significant effect of concentration on upper passing ability ($F = 10.78$, $p < 0.05$, $\eta^2 = 0.17$). These findings are consistent with Komarudin's (2020) research which shows that concentration plays an important role in the success of basic volleyball techniques. Weinberg and Gould (2019) assert that concentration allows athletes to focus attention on relevant cues and ignore unimportant distractions.

A high level of concentration helps players in reading the direction and speed of the ball better. Williams et al. (2020) added that good concentration also contributes to faster and more informed decision-making in dynamic game situations.

Interactions between Variables

A significant interaction was found between the three independent variables ($F = 8.92$, $p < 0.05$, $\eta^2 = 0.15$). The group with high eye-hand coordination, strong hand finger strength, and high concentration showed the best top passing performance. This is in accordance with the integrative model of motor skills put forward by Edwards (2021), which emphasizes the importance of integrating physical and mental components in sports performance.

This interaction shows that the three variables work synergistically in determining the success of the top pass. According to Richardson et al. (2020), the optimization of one component will give better results if it is supported by other components that are also optimal.

Practical Implications

The findings of this study have several practical implications for the development of exercise programs: a). The importance of integrated exercises that integrate coordination, strength, and mental aspects, as recommended by Thompson (2021).

b). The need for a systematic and progressive training program to develop all three components simultaneously (Haff & Triplett, 2022). c). The importance of periodic evaluation of all three components to monitor athlete development (Joyce & Lewindon, 2021).

CONCLUSION

Based on the results of the study on the influence of eye-hand coordination, finger strength, and concentration on the upper passing ability in volleyball in extracurricular students of MTs Negeri 1 Prabumulih, it can be concluded that the three independent variables have a significant influence on the upper passing ability. The results of the analysis showed that eye-hand coordination had a significant influence with a value of $F = 15.32$ ($p < 0.05$) and effect size $\eta^2 = 0.23$, where students with high eye-hand coordination showed better upper passing ability compared to students with low eye-hand coordination. The strength of the fingers was also proven to have a significant influence with a value of $F = 12.45$ ($p < 0.05$) and an effect size of $\eta^2 = 0.19$, where students with strong hand finger strength had better upper passing ability compared to students with weak hand finger strength. Similarly, the concentration variable showed a significant influence with a value of $F = 10.78$ ($p < 0.05$) and effect size $\eta^2 = 0.17$, where students with a high concentration level showed better upper passing ability compared to students with a low concentration level. Furthermore, there was a significant interaction between the three variables ($F = 8.92$, $p < 0.05$, $\eta^2 = 0.15$), where the group of students with a combination of high eye-hand coordination, strong hand finger strength, and high concentration showed the best results in upper passing ability.

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