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The Effect of Interaction between Training Methods and Eye-Hand Coordination on the Accuracy of the Forehand Groundstroke of Court Tennis

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ABSTRACT: This study aims to determine the Effect of Training Methods on the Accuracy of Court Tennis Reviewed from Eye-Hand Coordination. This study uses a 2x2 factorial design experiment, which is an experimental design method that combines several independent variables while still considering the potential impact of factorials. Moderator variable on the outcome or independent variable. This research was carried out at the Kentoeng Tennis *Academy* Sukoharjo Field, Pojok, Mulur, Bendosari District, Sukoharjo Regency. There was no effect of interaction between eye-hand treatment and coordination on the improvement of accuracy *Groundstroke forehand*. This is evidenced by the results of the anova statistical test with a probability value of 0.841 > 0.05. The test results with 2-way anova statistics were obtained in the interaction test, a calculated f value of 0.042 and a probability of 0.841. Based on the criteria mentioned above, the probability of > 0.05 means that the interaction factor does not affect the improvement of the accuracy of *the forehand groundstroke of* the court. The interaction factor means that the training method and eye-hand coordination do not work together to improve the accuracy of *the forehand groundstroke* court tennis. So, Hypothesis 3 which states: there is an interaction between training methods and eye-hand coordination on improving the accuracy of *the forehand groundstroke of* the tennis court, is rejected.

KEYWORDS: Training Methods, Eye-Hand Coordination, Court Tennis

INTRODUCTION

Doing physical activity, commonly called sports, is a popular activity among the public. Not only does it maintain health and fitness, but it also serves as a means for education as well as achievement and encourages the development of individuals with enhanced quality (Mora et al., 2019). In today's society, the existence of human beings is closely related to sports activities. Exercise has become a lifestyle for humans today. There are various kinds of benefits that are very much obtained from sports activities. Engaging in sports is essential for maintaining physical health and strengthening the muscles in the body (Filanowski et al., 2021). Sports can also maintain a person's physical fitness so that they are always fit, a means for education, a means to achieve achievements and is also a lifestyle for humans (Khoramipour et al., 2020).

Court tennis is a sport that is of interest to most of Indonesia's population today and has a variety of goals. The main goal of tennis is to meet the needs of education, recreation, and achievement (Ngatman & Sulistyatna, 2017). As an educational endeavor, tennis has been integrated into school curricula at all levels, demonstrating its role in achieving national education goals. Therefore, tennis is to cultivate children's potential and talents, thus shaping them into skilled, intelligent, and noble players. In addition, as a recreational effort, tennis offers a means to fill leisure time that is commonly used by families, communities, and government and private organizations (Agustiyanta et al., 2022). The participants exercised happily while sharing laughter, not only to fill their free time but also to refresh themselves physically. Tennis also serves to achieve competitive achievements in Regional and National tournaments. The presence of tennis in Indonesia has an important meaning not only at the national level but also in the international arena. This means that court tennis can contribute to the development of the Nation and State as a whole. But to achieve success in tennis, especially in terms of achievement, takes a lot of time and effort. Aspiring individuals with potential and talent in tennis strive to achieve this goal (Fetisova et al., 2021). Coaches play an important role in honing and perfecting these potentials and talents, transforming players into reliable and skilled athletes who are able to provide optimal performances (Elce et al., 2017). The achievement of high achievements in tennis opens the door to a promising future. Therefore, improving tennis performance is important, especially for players whose potential has not been explored and there is still room for improvement. By synergizing the above factors, achievements can be achieved.

The Effect of Interaction between Training Methods and Eye-Hand Coordination on the Accuracy of the Forehand Groundstroke of Court Tennis

Early childhood coaching is essential for improving achievement because it allows for optimal development and direction of talent through appropriate sports. Athlete coaching plays an important role in influencing the achievement and effectiveness of coaching (Zirhli & Demirci, 2020). The process of achievement coaching in sports generally follows the pyramid theory which consists of the stages of problem solving, breeding, and achievement coaching. In addition, talent identification is essential in sports, allowing for the discovery of talented candidates, the initial selection of prospective athletes, ongoing monitoring, and assistance on their path to the professional ranks.

Various factors that affect sports achievement include accuracy and suitability in choosing sports. The opportunity for athletes to achieve the desired achievement will be easier if they have interests and talents with the sport they are engaged in. To achieve maximum achievement in the world of tennis, one must have a comprehensive understanding of four essential elements: technique, tactics, mentality, and physical strength. Athletes' performance and achievements can be significantly improved through proper mastery of technique (Nugroho et al., 2023). When involved in the game of tennis, there are many basic techniques that require mastery. These techniques include: services, forehand, backhand, volley, smash, dropshot and lob. The various basic techniques above if mastered well, can have the opportunity to become a reliable tennis player (Zetou et al., 2014).

Blow forehand is a basic technique that is often used in the sport of tennis. This stroke involves hitting the ball directly after it hits the ground. Forehand is considered the most basic and easy to teach in tennis. This technique requires a swinging motion that starts from the right side of the body and moves forward, with the racket or palm facing the ball. Beginners can choose a continental or eastern grip when holding a tennis racket (Myburgh et al., 2016). In addition, the recommended attitude to hit the ball is a closed attitude, namely the position of the left foot facing forward and the body perpendicular to the baseline or net. This placement ensures that the shoulders are oriented towards the net. Groundstroke forehand is a stroke made from the right side of the waist where the position of the back of the hand holds and swings the racket until it hits the ball (Impact) and pass the net until the racket position is in front of the body (follow through). If the player is more dominant using the left hand, then the position is opposite.

A reliable tennis player has a shot groundstroke which is strong on the forehand and backhand sides. Technique forehand for beginners, they must be mastered first before mastering other techniques. Until the next level to the highest level of technique forehand became a deadly mainstay technique for opponents. Blow Groundstroke forehand It involves the integration of three different phases: backswing, touchpoint, and follow-up. It is very important that these stages become a movement that occurs simultaneously. A court tennis coach must know the extent of his athletes' ability to master the technique. The ability of the athlete can be known through a basic technical skill test (Rota et al., 2012). The goal is to see to what extent the level of consistency, accuracy and which strokes have more chances of generating points to win the match.

Coordination skills involve the smooth and precise execution of several motor tasks simultaneously. Athletes who lack coordination often exhibit stiff and tense movements, resulting in unnecessary energy expend due to inefficiency (Dahiya, 2017). This lack of efficiency also extends to eye-hand coordination, which directly impacts the accuracy of the punch Groundstroke forehand. Punch execution Groundstroke forehand Relying on the alignment of eye-hand coordination, and other parts of the body to achieve the desired movement. Therefore, eye-hand coordination refers to the synchronization of movements between the eyes and hands when performing a certain action.

Court tennis is a sport that is full of risk of error. Tennis players can make mistakes by using improper strategies that benefit their opponents, the ball getting stuck in the net or sending it out of bounds. To minimize mistakes in playing tennis, it is important to demonstrate a certain level of precision and accuracy. In addition to ball speed, accuracy is also important in the success of the game, even higher ball speeds and stroke accuracy forehand has been associated with a higher player experience, high ball speed and high accuracy are required for the best performance. In improving the accuracy of the shot Groundstroke forehand court tennis, the training method that can be used is by Cross-court pairs and Precision with tempo. Cross-court pairs and Precision with tempo aims to improve consistency, precision and accuracy, speed up stroke tempo and endurance.

Kentoeng Tennis Academy is one of the best court tennis clubs in Sukoharjo Regency. The purpose of establishing Kentoeng Tennis Academy is to produce the best talents of court tennis athletes. Kentoeng Tennis Academy was established by Mr. Andhy Sutomo on October 19, 2009 at the Gelora Merdeka Tennis Court, Sukoharjo. Kentoeng Tennis Academy also has a private tennis court for training located in Mulur Village, Bendosari District, Sukoharjo Regency. There have been many achievements produced by his athletes and often try out at home or abroad.

Based on the observation results, the skill and accuracy factors in Groundstroke forehand in Kentoeng Tennis Academy Visible stroke skills and accuracy Groundstroke forehand has not been maximized. This is not only true in matches, but also in training sessions, where athletes often make mistakes such as hitting the ball in the net, the ball off the court, and having difficulty returning the opponent's shot when Rally. It is essential for athletes to receive training to improve their stroke skills and accuracy, thus allowing them to hit the right shots with minimal their own mistakes. The ability to hit skillfully and accurately is a determining factor in a player's success in a match.

METHOD

This study uses a 2x2 factorial design experiment, which is an experimental design method that combines several independent variables while still considering the potential impact of factorials. Moderator variable to the outcome or independent variable. This research was carried out in Kentoeng Field Tennis Academy Sukoharjo, Pojok, Mulur, Bendosari District, Sukoharjo Regency.

The variables in this study consisted of 2 independent variables (independent) and one bound variable (dependent) with details namely:

1. Independent Variable

a. The manipulative variable is an exercise method consisting of 2 levels.
   1) Cross-court pairs training method.
   2) Precision with tempo training method.

b. The attributive free variables in this study are:
   1) High eye-hand coordination.
   2) Eye-hand coordination is low.

2. Dependent Variable

In this study, the bound variable is accuracy Groundstroke forehand court tennis.

To ensure an accurate analysis, it is important to perform a prerequisite test before proceeding with hypothesis testing. This research will focus on examining the normality and homogeneity of measurement data, as it plays an important role in improving the quality of analysis.

1. Prerequisite Test

a. Normality Test

Purpose The normality test is to find out whether the sample distribution is normal or not. For this study, the normality test used is the Lilliefors method. The data obtained from the results of forehand groundstroke were analyzed using one-way ANOVA statistics and hypothesis tests, namely by calculating the F test at a significance level of 0.05%. Before conducting these tests, it is necessary to carry out prerequisite tests such as sample normality test (Lilliefors test with $\alpha = 0.05\%$) and variance homogeneity test (Bartlett test with $\alpha = 0.05$).

Here are the steps needed to perform the Lilliefors method and calculate the normality test.

1) Arrange the data in ascending order, starting with the smallest value and ending with the largest value.
2) From the data, each Z score is sought. With the formula: Zi= Xi – Mean / sd
3) From that Z score and using the normal distribution list, calculate the odds of F(Zi)
4) Then the proportions of Z1, Z2, Z3, ... etc. that is smaller or equal to Zi then divided by the number of samples
5) Calculate the difference F(Zi) - S(Zi). Determine the absolute price
6) The biggest price is the sought-after Lcount
7) The Lcount is compared with the Ltabel in the table of critical values for the liliefors test if the Lcal< Ltabel then the data is normally distributed.

b. Homogeneity Test

The purpose of the homogeneity test is to assess whether the program exhibits homogeneity in the sample population. To determine the homogeneity, the F test was used which compared Ftabel and Fcal. If the Ftabel is smaller than the Fcal, it means that the data group is homogeneous. In this study, the F test is calculated using a predetermined formula:

$$F = \frac{S\frac{2}{1}}{S\frac{2}{2}}$$

Information:

$S\frac{2}{1}$ = Variance group 1

$S\frac{2}{2}$ = Variance group 2

2. Hypothesis Test

This study uses the IMB SPSS 23.0 application with the Two-Way Anova with the number of samples based on eye-hand coordination. The purpose of this test was to find out how much the intervention of the independent variable of the exercise method was affected Cross-Court Pairs and precision with tempo towards Groundstroke forehand. The results of the value with a significance level of 5% (0.05).

RESULTS AND DISCUSSION

Table 1. Description Combination of Eye-Hand Coordination and Training Methods

Observation	Phase	N	Minimum	Maximum	Mean	Std. Deviation
High KMT CCP	Pretest	5	12,5	24,5	20	4,937
	Posttest	5	19	30	23,7	3,994
	difference	5	-5,5	17,5	3,7	8,592
High PWT KMT	Pretest	5	17	28	21,3	4,604
	Posttest	5	23	29	27,2	2,490
	difference	5	1	12	5,9	3,943
Low KMT CCP	Pretest	5	12,5	23	19,4	4,204
	Posttest	5	15	25,5	20,8	4,563
	difference	5	-4	10	1,4	5,561
Low KMT PWT	Pretest	5	17	27	20,7	3,899
	Posttest	5	16	29	23,2	5,119
	difference	5	-4,5	8	2,5	4,950

The results of the descriptive statistical test in the table above show that the average value of the forehand groundstroke accuracy in cross-court pairs of eye-hand coordination is high of 20 with a standard deviation value of 4.937. The minimum pretest value of forehand groundstroke accuracy in cross-court pairs of eye-hand coordination was 12.5 and the maximum value was 24.5.

The results of the descriptive statistical test in the table above show that the average value of the forehand groundstroke accuracy posttest in cross-court pairs of eye-hand coordination is high at 23.7 with a standard deviation value of 3.994. The minimum posttest value of forehand groundstroke accuracy in cross-court pairs of eye-hand coordination is high of 19 and the maximum value is 30.

The results of the descriptive statistical test in the table above show that the average value of the difference in forehand groundstroke accuracy in cross-court pairs of eye-hand coordination is 3.7 with a standard deviation value of 8.592. The minimum value of the difference in forehand groundstroke accuracy in cross-court pairs of eye-hand coordination was -5.5 and the maximum value was 17.5.

The results of the descriptive statistical test in the table above show that the average value of the forehand groundstroke accuracy pretest at the precision with the tempo of eye-hand coordination is high of 21.3 with a standard deviation value of 4.604. The minimum pretest value of forehand groundstroke accuracy at precision with high eye-hand coordination tempo was 17 and the maximum value was 28.

The results of the descriptive statistical test in the table above show that the average value of the forehand groundstroke accuracy posttest at the precision with the tempo of eye-hand coordination is high of 27.2 with a standard deviation value of 2.49. The minimum posttest value of forehand groundstroke accuracy at precision with high eye-hand coordination tempo was 23 and the maximum value was 29.

The results of the descriptive statistical test in the table above show that the average value of the difference in the accuracy of the forehand groundstroke at the precision with the tempo of eye-hand coordination is high of 5.9 with a standard deviation value of 3.943. The minimum value of the difference in the accuracy of the forehand groundstroke at the precision with the tempo of eye-hand coordination is high of 1 and the maximum value is 12.

The results of the descriptive statistical test in the table above show that the average pretest value of forehand groundstroke accuracy in cross-court pairs of eye-hand coordination is low at 19.4 with a standard deviation value of 4.204. The minimum pretest value of forehand groundstroke accuracy in cross-court pairs of eye-hand coordination was low of 12.5 and the maximum value was 23.

The results of the descriptive statistical test in the table above show that the average posttest value of forehand groundstroke accuracy in cross-court pairs of eye-hand coordination is low at 20.8 with a standard deviation value of 4.563. The minimum posttest value of forehand groundstroke accuracy in cross-court pairs of eye-hand coordination was low of 15 and the maximum value was 25.5.

The results of the descriptive statistical test in the table above show that the average value of the difference in forehand groundstroke accuracy in cross-court pairs of eye-hand coordination is low of 1.4 with a standard deviation value of 5.561. The

minimum value of the difference in forehand groundstroke accuracy in cross-court pairs of eye-hand coordination was low of -4 and the maximum value was 10.

The results of the descriptive statistical test in the table above show that the average value of the forehand groundstroke accuracy pretest at the precision with the tempo of eye-hand coordination is low of 20.7 with a standard deviation value of 3.899. The minimum pretest value of forehand groundstroke accuracy at precision with eye-hand coordination tempo was low of 17 and the maximum value was 27.

The results of the descriptive statistical test in the table above show that the average posttest value of forehand groundstroke accuracy at precision with low eye-hand coordination tempo is 23.2 with a standard deviation value of 5.119. The minimum posttest value of forehand groundstroke accuracy at precision with eye-hand coordination tempo was low of 16 and the maximum value was 29.

The results of the descriptive statistical test in the table above show that the average value of the difference in the accuracy of the forehand groundstroke at the precision with the tempo of eye-hand coordination is low of 2.5 with a standard deviation value of 4.95. The minimum value of the difference in the accuracy of the forehand groundstroke at the precision with the tempo of eye-hand coordination is low of -4.5 and the maximum value is 8.

Table 2. Normality Test for Combination Eye-Hand Coordination Group Improvement Test and Treatment

		Shapiro-Wilk				
Cell	Phase	Statistics	Df	Sig.	Test	Statistical Test
A1B1	Pretest	0,885	10	0,149	Usual	paired t test
	Posttest	0,915	10	0,317	Usual	
A2B1	Pretest	0,968	10	0,868	Usual	paired t test
	Posttest	0,857	10	0,07	Usual	
A1B2	Pretest	0,945	10	0,608	Usual	paired t test
	Posttest	0,958	10	0,766	Usual	
A2B2	Pretest	0,946	10	0,624	Usual	paired t test
	Posttest	0,903	10	0,235	Usual	

Based on the results of the data test with the Shapiro-Wilk technique, it can be known that the p (sig) value in the pretest A1B1 of 0.473 with a value of > 0.05 and at posttest A1B1 of 0.548 which has a value of > 0.05 so pretest A1B1 and posttest A1B1 was declared normal. The results show that the assumption of normality is met so that the statistical test used is a paired t-test.

Based on the results of the data test with the 0.911 technique, it can be seen that the p (sig) value in the A2B1 pretest is 0.437 which has a value of > 0.05 and in the A2B1 posttest of 0.09 which has a value of > 0.05 so that the A2B1 pretest and A2B1 posttest are declared normal. The results show that the assumption of normality is met so that the statistical test used is a paired t-test.

Based on the results of the data test with the technique of 0.905, it can be seen that the p value (sig) in the A1B2 pretest is 0.25 which has a value of > 0.05 and in the A1B2 posttest is 0.421 which has a value of > 0.05 so that the A1B2 pretest and A1B2 posttest are declared normal. The results show that the assumption of normality is met so that the statistical test used is a paired t-test.

Based on the results of the data test with the 0.866 technique, it can be known that the p (sig) value in the A2B2 pretest is 0.375 which has a value of > 0.05 and in the A2B2 posttest of 0.883 which has a value of > 0.05 so that the A2B2 pretest and A2B2 posttest are declared normal. The results show that the assumption of normality is met so that the statistical test used is a paired t-test.

The test results with a 2-way anova were obtained in the interaction test, a calculated f value of 0.042 and a probability of 0.841. Based on the criteria mentioned above, the probability of > 0.05 means that the interaction factor does not affect the increase in accuracy Groundstroke forehand court tennis. Interaction means that the training methods and eye-hand coordination do not work together to improve accuracy Groundstroke forehand court tennis. So Hypothesis 3 states: There is an interaction between the training method and eye-hand coordination on increasing accuracy Groundstroke forehand Court tennis, rejected.

Spy-Hand Coordination Interaction and Treatment

The test results with a 2-way anova were obtained in the interaction test, a calculated f value of 0.042 and a probability of 0.841. Based on the criteria mentioned above, the probability of > 0.05 means that the interaction factor does not affect the increase in accuracy Groundstroke forehand court tennis. Interaction means that the training methods and eye-hand coordination do not work together to improve accuracy Groundstroke forehand court tennis. So Hypothesis 3 states: There is an interaction between the training method and eye-hand coordination on increasing accuracy Groundstroke forehand Court tennis, rejected.

The Effect of Interaction between Training Methods and Eye-Hand Coordination on the Accuracy of the Forehand Groundstroke of Court Tennis

The results of the interaction factors can actually be seen in the cross line between the treatment and the coordination of the eyes. Detect graphically, namely if there is a cross line between the two factors. The results of the calculation are presented as follows.

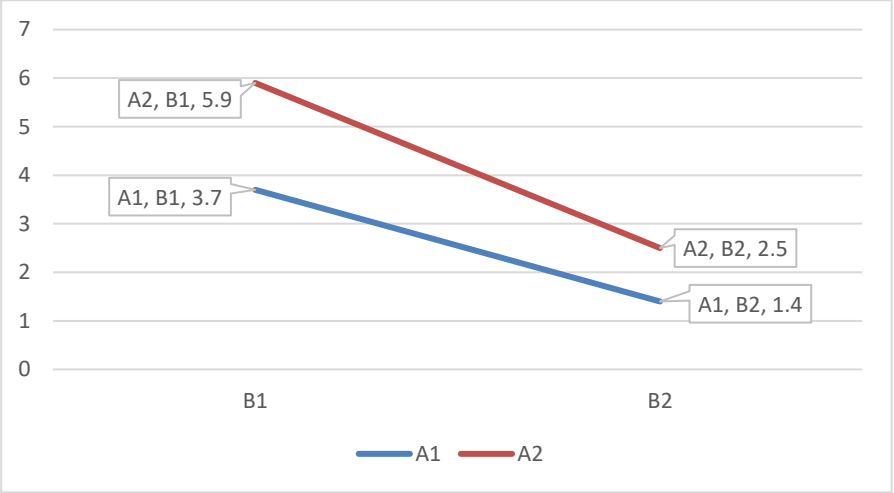

Figure 1. Plot of Eye-Hand Treatment and Coordination Interaction

Graphically, it can be seen that there is no line crossing between factor A (treatment) and factor B (eye-hand coordination). So that the observation graphically shows the absence of interaction factors A and B, as well as statistical calculations, it has been concluded that the interaction is not significant. In the figure above, it is known that the A1 treatment (exercise cross-court pairs) lines below the A2 treatment (precision with tempo). This means training precision with tempo tends to be better than exercise cross-court pairs both in the high and low eye-hand coordination groups, precision with tempo tend to be better.

In this section the author explains the comparison in the exercise group cross-court pairs but compared high eye-hand coordination with low eye-hand coordination, namely A1B1xA1B2.

Table 3. Comparison between Cell Group A1B1 and A1B2

Cell	Label	Mean	Sig.	Conclusion
A1B1	Cross-court pairs training on high eye-hand coordination	3,7	0,554	insignificant
A2B1	Cross-court pairs training on low eye-hand coordination	1,4		

In the exercise group cross-court pairs in high eye-hand coordination (A1B1) obtained an average increase of 3.7 while in the exercise group cross-court pairs in low eye-hand coordination (A1B2) an average increase of 1.4 was obtained. When compared to the two, the exercise group cross-court pairs in high eye-hand coordination (A1B1) had a higher increase in height compared to the exercise group cross-court pairs on low eye-hand coordination (A1B2). The results of the statistical test of the advanced test (post hoc) obtained a probability value of 0.554> 0.05 which means the difference between the exercises cross-court pairs on high eye-hand coordination (A1B1) with exercise cross-court pairs in low eye-hand coordination (A1B2) was declared insignificant. Based on the statement for practice cross-court pairs then the practice cross-court pairs on high eye-hand coordination (A1B1) is better than exercise cross-court pairs on low eye-hand coordination (A1B2) although the difference between the two is not noticeable.

In this section the author explains the comparison in the exercise group precision with tempo but compare high eye-hand coordination with low eye-hand coordination, namely A2B1xA2B2.

Table 4.Comparison between A2B1 and A2B2 cell groups

Cell	Label	Mean	Sig.	Conclusion
A1B1	Precision with tempo training on high eye-hand coordination	5,9	0,385	insignificant
A2B1	Precision training with tempo on low eye-hand coordination	2,5		

In the exercise group precision with tempo in high eye-hand coordination (A2B1) obtained an average increase of 5.9 while in the exercise group precision with tempo in low eye-hand coordination (A2B2) an average increase of 2.5 was obtained. When compared to the two, the exercise group precision with tempo in high hand-eye coordination (A2B1) had a higher increase in height compared to the exercise group precision with tempo on low-hand-eye coordination (A2B2). The results of the statistical test of the advanced test (post hoc) obtained a probability value of 0.385> 0.05 which means the difference between the exercises precision with tempo on high eye-hand coordination (A2B1) with exercise precision with tempo in low eye-hand coordination (A2B2) was declared insignificant. Based on the statement for practice precision with tempo so precision with tempo on high hand-eye coordination (A2B1) is better than precision with tempo on low eye-hand coordination (A2B2) although the difference between the two is not noticeable.

Table 5. Anova statistic obtained in the interaction test

cross mean	B1	B2	F	p
A1	3,7	1,4	0,042	0,841
A2	5,9	2,5		

The results of the test with the 2-way anova statistic obtained in the interaction test obtained a calculated f value of 0.042 and a probability of 0.841. Based on the criteria mentioned above, the probability of > 0.05 means that the interaction factor does not affect the improvement of the accuracy of the forehand groundstroke of the tennis court. The interaction factor means that the training method and eye-hand coordination do not work together to improve the accuracy of the forehand groundstroke of the tennis court. So Hypothesis 3 which states: there is an interaction between training methods and eye-hand coordination on improving the accuracy of the forehand groundstroke of court tennis, is rejected

CONCLUSION

There was no effect of interaction between eye-hand treatment and coordination on the improvement of accuracy Groundstroke forehand. This is evidenced by the results of the anova statistical test with a probability value of 0.841 > 0.05. The test results with 2-way anova statistics were obtained in the interaction test, a calculated f value of 0.042 and a probability of 0.841. Based on the criteria mentioned above, the probability of > 0.05 means that the interaction factor does not affect the improvement of the accuracy of the forehand groundstroke of the court. The interaction factor means that the training method and eye-hand coordination do not work together to improve the accuracy of the forehand groundstroke court tennis. So, Hypothesis 3 which states: there is an interaction between training methods and eye-hand coordination on improving the accuracy of the forehand groundstroke of the tennis court, is rejected.

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