The Effect of Eye-Hand Coordination Training on Underhand Passing Skills in Volleyball in Students of SMPN 17 Pamulang

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Article Info	Abstract
	This study aimed to examine the effect of eye–hand coordination training on improving underhand passing skills in volleyball among students of SMPN 17 Pamulang. Underhand passing is a fundamental technique that requires accuracy, strength, and good visual–motor coordination; however, many students still experience difficulties in controlling the direction and force of the ball. This research employed an experimental method using a non-equivalent control group design. The sample consisted of 30 eighth-grade students, divided into an experimental group and a control group, each comprising 15 students. The experimental group received eye–hand coordination training over eight sessions, while the control group followed conventional learning activities. Data were collected through underhand passing skill tests and eye–hand coordination tests administered before (pretest) and after the treatment (posttest). Data analysis included the Shapiro–Wilk test for normality, Levene's test for homogeneity, Paired Sample t-test, and Independent Sample t-test with a significance level of 0.05. The results indicated a significant improvement in the experimental group between the pretest and posttest (p < 0.05), demonstrating that eye–hand coordination training had a positive effect on underhand passing skills. Furthermore, the comparison between groups showed a significant difference in passing ability, but no significant difference in the coordination variable. Therefore, eye–hand coordination training was proven to be effective in enhancing underhand passing skills of junior high school students. This study recommends that physical education teachers incorporate coordination training as part of volleyball instruction to improve students' fundamental technical skills.

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1. INTRODUCTION

Physical education is an integral part of overall education, aiming to develop students' physical fitness, motor skills, sportsmanship, and social skills through planned physical activities (Ramadhani et al., 2024). One of the sports taught in physical education at the junior high school (SMP) level is volleyball. This game not only serves as a means of learning motor skills but also serves as a medium for character development in students, such as cooperation, responsibility, and sportsmanship (Kusbani & Jurya, 2021). In volleyball, there are several basic techniques that must be mastered by each player, including serving, underhand passing, overhand passing, smashing, and blocking (Akbar et al., 2025). Among these techniques, underhand passing plays a crucial role because it is the basis for controlling the first ball after receiving an attack or serve from the opponent.

A team's success in attacking depends heavily on the quality of good underhand passing (Andini, 2023). However, in practice, junior high school students' underhand passing skills are often still low, characterized by balls that are not directed, the ball bouncing too high or too low, and difficulty in controlling the speed of the ball.

One factor influencing underhand passing ability is hand-eye coordination (Setiawan & Anggara, 2024). This coordination is a person's ability to control precise hand movements based on visual information received by the eyes. In the context of volleyball, hand-eye coordination is essential for players to predict the direction the ball is coming from, determine the correct body position, and move their hands at the appropriate time and angle to bounce the ball in the desired direction (Asmarani, 2025). Without good coordination, players will have difficulty controlling their movements, resulting in the ball often missing its target or going out of control.

Field observations indicate that students at SMPN 17 Pamulang still struggle to effectively execute underhand passing techniques. Based on initial observations at the school, most students cannot control the direction and power of the ball. This may be due to students' poor hand-eye coordination, as they rarely engage in specific exercises that emphasize developing this coordination. Physical education instruction in schools generally focuses on direct technical mastery without addressing supporting aspects of basic motor skills such as coordination, agility, and balance (Iswanto & Widayati, 2021).

Hand-eye coordination training is essential to incorporate into volleyball learning. This training can be done through various simple activities, such as catching and throwing a small ball, bouncing the ball against a wall, playing catch in pairs, or practicing passing with varying directions and distances (Ginting & Sari, 2021). Through structured and repetitive practice, students become accustomed to controlling their hand movements based on visual perception, thereby improving their ability to execute underhand passes. Furthermore, the hand-eye coordination training approach can provide a more enjoyable learning experience for students. Game-based exercises can increase learning motivation and active participation in physical education (Soemaryoto, 2023). Increased student motivation and engagement will also optimize learning outcomes.

Several previous studies support the importance of coordination training in improving volleyball skills. For example, research conducted by several physical education experts shows that eye-hand coordination has a significant contribution to underhand passing ability (Gunawan et al., 2025). The results of this study prove that the better a person's eye-hand coordination, the better their ability to control the ball and perform underhand passing techniques precisely and efficiently. Based on this description, it can be concluded that the low underhand passing skills of students at SMPN 17 Pamulang are thought to be related to the lack of eye-hand coordination training in the volleyball learning process. Therefore, a study is needed that scientifically examines the effect of eye-hand coordination training on underhand passing skills in volleyball in SMPN 17 Pamulang students. This study is expected to provide an empirical picture of the role of eye-hand coordination in basic volleyball technical skills, as well as provide considerations for physical education teachers to develop more effective and engaging training methods for students.

2. MATERIALS AND METHODS
Research Design

This research uses a quantitative approach with a quasi-experimental method (*as if an experiment*), namely a study that aims to determine the effect of a treatment (*treatment*) on certain variables with conditions that do not allow full control over all external variables (Sugiyono, 2019). The research design used is a Non-Equivalent *Control Group Design*, where two groups are not selected randomly, namely the experimental group and the control group. Both groups are given a pretest and a *posttest to* find out the difference in results before and after treatment.

The experimental group received hand-eye coordination training, while the control group participated in regular volleyball learning activities without additional training. Comparing the results between the two groups will serve as the basis for determining the effect of coordination training on the volleyball passing skills of students at SMPN 17 Pamulang.

The variables in this study consist of two types, namely independent variables and dependent variables. The independent variable (X) is hand-eye coordination exercises, namely a series of training activities designed to train the harmony between hand movements and vision in catching, throwing, or bouncing the ball. Meanwhile, the dependent variable (Y) is the skill of passing under the ball in volleyball, which is defined as the student's ability to perform the ball passing techniques correctly, directed, and controlled according to the basic principles of volleyball.

The independent variable in this study was hand-eye coordination training, a series of exercises aimed at improving students' ability to coordinate hand movements with their vision of objects, particularly the ball. Hand-eye coordination is an essential fundamental skill in various sports, particularly volleyball, which demands precision and rapid reaction times. Coordination training in this study was provided through various activities involving the visual and motor systems, such as throwing and catching, bouncing, passing quickly with a teammate, and reacting to changes in the ball's direction. These exercises were structured over eight sessions, each lasting 30 to 40 minutes, and were conducted before the main volleyball game began. It was hoped that these exercises would improve students' ability to react quickly and accurately to the direction of the incoming ball. Meanwhile, the dependent variable in this study was the underhand passing skill in volleyball, which is the students' ability to perform the basic underhand passing technique correctly and effectively. Underhand passing is a basic technique in volleyball that serves to receive and direct the ball from an opponent's serve or attack to a teammate. This skill requires good body coordination, strength, and motor control. Underhand passing skills are assessed through a practical test that assesses several aspects, including body and foot position, hand and arm position upon contact with the ball, accuracy of the ball's direction toward the target, and the ability to control the ball's bounce to maintain stability. The assessment is conducted by two examiners using an observation sheet with a rating scale of 1–5. The results are then converted to a score scale of 0–100 to obtain the student's final skill score.

In the context of this study, improving students' underhand passing skills is considered a result of consistent and ongoing hand-eye coordination training. With improved visual-motor coordination, students will be better able to predict the direction of the ball, adjust their body position correctly, and direct the ball to the target accurately. Therefore, hand-eye coordination training is expected to have a significant impact on volleyball underhand passing skills. Therefore, the operational definitions of these two variables provide clear boundaries regarding what is measured, how it is measured, and the indicators used to assess training results. This approach simplifies data collection

and analysis, allowing the research results to provide a valid and reliable picture of the effect of hand-eye coordination training on volleyball underhand passing skills in students at SMPN 17 Pamulang.

Participants

Participants in this study were students from SMP Negeri 17 Pamulang who were participating in Physical Education, Sports, and Health (PJOK) learning activities. Sample selection was based on age uniformity, basic volleyball skills, and active participation in school sports learning activities. This research uses the technique of purposive *sampling*, namely sampling based on certain considerations or criteria relevant to the research objectives. The sample criteria in this study include: (1) Active students in class VIII of SMPN 17 Pamulang who are taking the PJOK subject, (2) Students who are in healthy physical condition and have not experienced any injuries that would hinder training activities, (3) Students who have never taken intensive volleyball training outside of school, (4) Willing to take part in the entire series of training sessions during eight meetings.

Based on these criteria, a sample of 30 students was obtained from the total population of eighth-grade students participating in volleyball lessons. The sample was then divided into two groups, namely: (a) The experimental group consisted of 15 students who were given treatment in the form of eye and hand coordination exercises for eight meetings, (b) The control group consisted of 15 students who took part in volleyball lessons as usual without being given additional exercises.

Group assignment was randomized so that each participant had an equal chance of being in either the experimental or control group. This assignment was intended to objectively illustrate the effect of hand-eye coordination training on improving underhand passing skills. During the study, both groups underwent a baseline test (*pretest*) to measure the initial ability of underhand passing, as well as the final test (*posttest*) after all training sessions were completed. Pretest and posttest data were used to analyze differences in improvement in underhand passing skills between the experimental and control groups. With these sample sizes and characteristics, this study is expected to provide a representative picture of the effectiveness of hand-eye coordination training in improving underhand passing skills in junior high school students.

Research Instruments

Research instruments are tools used by researchers to collect data relevant to the variables being studied. In this study, the instruments used aimed to measure two main variables: hand-eye coordination (independent variable) and volleyball underhand passing skills (dependent variable).

a) Hand-Eye Coordination Instrument

To measure students' hand-eye coordination, a ball-to-wall throwing-and-catching test was used. This test was chosen because it is simple, easy to administer, and effective in assessing a person's visual-motor coordination abilities (Santy & Daharis, 2023).

b) Volleyball Underhand Passing Skill Instrument

To measure underhand passing skills, the underhand passing test to the target is used (*passing accuracy This* test has been widely used in physical education research because it is valid and reliable in measuring basic volleyball technical skills (Zikrillah & Merlinasari, 2024).

c) Validity and Reliability of Instruments

The instruments used in this study refer to standard volleyball skill tests used in previous studies. The hand-eye coordination test and the underhand passing test have been empirically

tested and found to have high validity and reliability for measuring basic motor skills in volleyball (Luciano et al., 2024).

d) Test Implementation

The test was conducted twice, namely: Pretest, before the training treatment was given, to determine the students' initial abilities, and Posttest, after eight training meetings, to determine the increase in students' abilities after being given the treatment.

The data from the two tests were then analyzed using a statistical test (t-test) to see if there were any significant differences between before and after being given eye and hand coordination training.

Research Procedures

Data collection techniques are a crucial step in the research process because they determine the quality and validity of the results. In this study, data were collected through testing and direct observation of students, both before and after the treatment was administered. Data collection consisted of two main stages: a pretest and a posttest, to measure changes that occurred after eight sessions of hand-eye coordination training (Sugiyono, 2018).

a) Data Collection Preparation Stage

Before the test, the researcher coordinated with the physical education (PJOK) teachers at SMPN 17 Pamulang to determine the schedule, location, and participants. Furthermore, a socialization session was conducted with the participants to ensure they understood the procedures and objectives of each test. At this stage, the researcher also ensured that all necessary equipment, such as balls, stopwatches, cones, and the field area, was ready for use.

b) Pretest Implementation

A pretest was conducted at the first meeting before the experimental group received the hand-eye coordination training. This test aimed to obtain baseline data on each participant's hand-eye coordination and underhand passing skills.

● Eye-hand coordination test: done by throwing and catching a ball against a wall for 30 seconds.

● Underhand passing skill test: done by passing towards the target 10 times. The pretest results are recorded and used as a basis for determining the students' initial ability level before the training program is given.

c) Treatment Implementation (Training)

After the pretest, the experimental group received eight sessions of hand-eye coordination exercises. Each session lasted approximately 35–40 minutes, with exercises designed to progress from simple to complex. Throughout the training process, researchers also directly observed the students' activeness, seriousness, and responses.

d) Posttest Implementation

The posttest was administered at the eighth meeting after the entire training session was completed. The test followed the same procedures as the pretest, including eye-hand coordination and underhand passing skills. The purpose of the posttest was to determine changes or improvements in students' abilities after receiving the treatment.

e) Data Recording and Documentation

All test results, both pretest and posttest, were systematically recorded on a score sheet. Each score was then processed for statistical analysis using a paired sample t-test to determine significant differences between pre- and post-training results. Additionally, documentation in the form of photographs or videos was used as supporting evidence throughout the research process.

3. RESULTS

Data analysis was conducted to determine the extent of the influence of hand-eye coordination training on improving volleyball underhand passing skills in students of SMPN 17 Pamulang. Data obtained from the results of the pretest and posttest were then analyzed descriptively and inferentially. Descriptive analysis was used to provide a general overview of the distribution of research data, including the lowest (minimum), highest (maximum), average (mean), and standard deviation (standard deviation) of each measured variable, both in the experimental and control groups. The results of this descriptive analysis aim to show the general trend and direction of changes in students' abilities before and after being given treatment in the form of hand-eye coordination training. The summary of the research data is as follows:

Table 1. Experimental Variable Data Description

	Pre-Passing	Post-Passing	Pre-Coord	Post-Coord
N	15	15	15	15
Mean	29.84	44.83	21.94	29.41
Std. Deviation	6.665	6.090	5.350	4.357
Variance	44.423	37.085	28.620	18.979
Minimum	20	30	13	20
Maximum	45	55	32	38

From the description table on the experimental group variables, the lowest value for pretest passing is 20 for posttest passing 30, the highest value for pretest passing is 45 for posttest passing 55, the average for pretest passing is 29.84 for posttest passing 44.83, the standard deviation for pretest passing is 6.66 for posttest passing 6.09 and the number of variances for each is 15 people, while for the lowest value for pretest coordination is 13 for posttest coordination 20, the highest value for pretest coordination is 32 for posttest coordination 38, the average for pretest coordination is 21.94 for posttest coordination 29.41, the standard deviation for pretest coordination is 5.35 for posttest coordination 4.35 and the number of variances for each is 15 people,

The interpretation is that there was an overall improvement. The descriptive data show that hand-eye coordination training had a significant positive impact on improving students' motor skills, particularly in volleyball underhand passing skills. The significant increase in the mean and decrease in the standard deviation indicate that the treatment given was not only effective in improving students' average abilities but also in stabilizing performance among individuals in the experimental group. Furthermore, the following table presents data on the control group variables as follows:

Table 2. Control Variable Data Description

	Pre-Passing	Post-Passing	Pre-Coord	Post-Coord
N	15	15	15	15
Mean	29.07	35.44	25.52	25.56
Std. Deviation	6.255	6.834	3.469	5.756
Variance	39.122	46.705	12.035	33.127
Minimum	22	26	18	18
Maximum	43	45	31	33

From the description table on the control group variable, the lowest value for pretest passing is 22 for posttest passing 26, the highest value for pretest passing is 43 for posttest passing 45, the average for pretest passing is 29.07 for posttest passing 35.44, the standard deviation for pretest passing is 6.25 for posttest passing 6.83 and the number of variances for each is 15 people, while for the lowest value for pretest coordination is 18 for posttest coordination 18, the highest value for pretest coordination is 31 for posttest coordination 33, the average for pretest coordination is 22.52 for posttest coordination 25.56, the standard deviation for pretest coordination is 3.47 for posttest coordination 5.76 and the number of variances for each is 15 people. The interpretation is that these results indicate that although conventional volleyball learning can provide a slight increase in students' underhand passing and eye-hand coordination abilities, the increase is still limited and uneven. This confirms that without special training that emphasizes the visual and motor coordination aspects, the improvement of students' skills tends to be slow and less optimal compared to students who receive directed training treatment, such as in the experimental group.

Based on several tests and test results of the *Independent Sample t-Test* in the table above, the results of the homogeneity of variance test (Levene's Test) for the Passing_Results variable show a significance value of 0.390. Because this value is greater than 0.05 (Sig. Levene's > 0.05), it is concluded that the data variance passing between the two groups is homogeneous. Assuming equal variances (*Equal variances assumed*), the results of the Independent Sample t-Test show a t value of -2.696 with degrees of freedom (*df*) 28, and the significance value (Sig. 2-tailed) or p-value is 0.012. Because the p-value of 0.012 is smaller than 0.05 ($p < 0.05$), it can be concluded that there is a statistically significant difference in the average ability of *Passing* between Group A and Group B, while the Test of Differences in the Average Coordination Ability of the results of the homogeneity of variance test (Levene's Test) for the Coordination Results variable shows a significance value of 0.003. Because this value is smaller than 0.05 (Sig. Levene's > 0.05), it is concluded that the variance of the data coordination between the two groups is not homogeneous (heterogeneous).

Therefore, the interpretation of the Independent Sample t-Test uses the following lines: *Equal variances not assumed*. The test results show a t value of -1.625 with degrees of freedom (*df*) 22,959, and the significance value (Sig. 2-tailed) or p-value is 0.118. Because the p-value of 0.118 is greater than 0.05 ($p > 0.05$), it can be concluded that there is no statistically significant difference in the average coordination ability between the two groups tested.

4. CONCLUSION

Based on a series of statistical analyses conducted, including normality tests, homogeneity tests, paired sample t-tests, and independent sample t-tests, it can be concluded that the intervention program has been proven effective in improving the subjects' internal abilities (pre-post). However, when comparing the final results between groups, the intervention was only able to create a significant difference in Passing ability, while in Coordination ability, both interventions had equivalent final results.

5. ACKNOWLEDGMENTS

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