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Navigating Perfection in Jump Serve Technique: Optimizing Eye-Hand Coordination among Physical Education Students

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Abstract This research aims to make a new contribution in developing jump serve skills in volleyball among physical education students at FKIP UNSAP Sumedang, with a focus on hand-eye coordination. This research approach is based on a correlational design which aims to explore the relationship between eye-hand coordination as an independent variable and jump serve skills as a dependent variable. The data collection method involved a ball throwing test to measure eye-hand coordination, while jump serve skills were measured through a serve test using the jump serve technique. This research uses a quantitative approach with descriptive statistical data analysis techniques to describe sample characteristics and data distribution, as well as inferential statistics to test hypotheses and identify a significant relationship between eye-hand coordination and jump serve skills. The main findings show a significant positive relationship between hand-eye coordination and service accuracy and strength, with a correlation coefficient reaching 0.655. These results confirm that improving hand-eye coordination has the potential to increase consistency and effectiveness in the jump serve technique. The implication of this research is the importance of including exercises that focus on developing visual-motor perception in volleyball training programs. This holistic integration not only enhances technical skills but also supports the athlete's comprehensive development on the field. Thus, these findings may aid in the development of more effective and evidence-based training methodologies to improve serve quality in volleyball in academic settings.

Keywords Hand-Eye Coordination, Jump Serve, Volleyball, Technical Skills, Holistic Training

1. Introduction

Jump serve is a service technique that requires good coordination between hand and eye movements to achieve optimal accuracy and strength in throwing the ball [1]. In this context, developing this skill is important because it can improve overall game performance, especially in volleyball competitions which require effective serving as a crucial element in winning points. Therefore, an in-depth understanding of how hand eye coordination contributes to improved jump serve technique can provide valuable insights for the development of more effective training methods in improving volleyball skills in academic settings [2].

On the field, there are several problems that arise related to the development of jump serve skills in volleyball among physical education students at FKIP UNSAP Sumedang. One of them is the low level of accuracy and consistency in performing the jump serve technique [3]. This could be caused by a lack of in-depth understanding

and practice regarding the hand-eye coordination required in this technique. In addition, factors such as physical fatigue, lack of understanding of the proper movement mechanisms, and lack of attention to aspects of motor coordination can also become obstacles in the development of this skill [4]. An in-depth understanding of how hand eye coordination can influence the accuracy and strength of serves is also a problem that needs to be addressed to improve the quality of jump serve techniques among physical education students at FKIP UNSAP Sumedang.

Previous research regarding the development of jump serve skills in volleyball has highlighted several important aspects. A number of studies regarding this service technique have focused on factors such as movement biomechanics, the influence of physical training, and psychological strategies to improve athlete performance [5]. For example, previous research has explored the role of hand-eye coordination in serve technique, although not specifically in the context of the jump serve. Several studies have also identified factors that influence serve accuracy and power, including the influence of repetitive training on the development of motor reflexes and emotional stability when serving [6]. However, most previous research tends to focus on technical and physical aspects without thoroughly integrating psychomotor and motor coordination aspects which are the main focus in this research. Therefore, although there have been significant efforts to understand the elements of the serve in volleyball, there is a need for more in-depth and focused research in exploring the optimal potential of the jump serve technique through a holistic and integrated approach.

The research gap in the context of developing jump serve skills in volleyball among physical education students at FKIP UNSAP Sumedang focuses on the lack of in-depth studies regarding the influence of hand eye coordination on service accuracy and consistency. Although the jump serve is an important service technique in modern volleyball, there is a need to identify specific factors that influence students' ability to master this technique, especially in the context of motor coordination between the eyes and hands. Previous studies have not explicitly explored how this aspect of coordination can be optimized through appropriate training approaches, which are appropriate to the context of physical education students in academic environments such as FKIP UNSAP Sumedang. Therefore, further research is needed to fill this gap by exploring it scientifically, to enrich understanding of the factors that influence the development of technical skills in volleyball.

This research aims to present a new contribution in developing jump serve skills in volleyball among physical education students at FKIP UNSAP Sumedang with a focus on hand eye coordination. The novelty of this research lies in a holistic approach in understanding and improving motor coordination between the eyes and hands in the context of the jump serve technique. This research will use a rigorous experimental approach to identify key factors influencing serve accuracy and consistency, taking into account the psychomotor and biomechanical aspects involved. In addition, this research will provide a deeper understanding of how structured and theory-based training can improve students' technical skills, so that the results can be applied practically to improve their performance in volleyball competitions. Thus, the novelty of this research will open new avenues in the development of effective and evidence-based training methodologies to improve service quality in volleyball in academic settings.

2. Materials and Methods

In this research, a correlational design was employed to explore the relationship between hand-eye coordination (X) and jump serve skills (Y) among participants. Hand-eye coordination was identified as the independent variable, while jump serve skills were considered the dependent variable. This design allows for an examination of how variations in hand-eye coordination may affect the ability to execute jump serves effectively. By understanding this relationship, the research aims to highlight the importance of hand-eye coordination as a foundational skill in enhancing volleyball performance.

To measure hand-eye coordination, a ball throwing and catching test was implemented. Participants stood 3 meters away from a shoulder-high target affixed to a wall. The task involved bouncing a ball off the wall and catching it within a 30-second timeframe. This test was designed to assess participants' ability to coordinate their visual perception with their motor responses, a critical component of effective jump serving. The performance on this test provided a quantifiable measure of hand-eye coordination that could be analyzed in relation to jump serve skills.

Jump serve skills were evaluated through a specific serve test that utilized the jump serve technique. Participants executed jump serves while being assessed on various aspects such as power, accuracy, and overall technique. The data collected from both tests were analyzed using a quantitative approach. Descriptive statistics were employed to characterize the sample and illustrate data distribution, while inferential statistics were applied to test hypotheses and determine significant relationships between hand-eye coordination and jump serve skills. This comprehensive analysis aimed to deepen the understanding of how hand-eye coordination influences the technical proficiency of jump serves in volleyball, ultimately providing insights that could inform training practices.

The training program over the 8 weeks consisted of a structured regimen designed to enhance the participants' jump serve strength. Each week included a combination of plyometric exercises, strength training, and specific jump serve drills. Plyometric exercises focused on developing explosive power, with activities such as box jumps and

depth jumps. Strength training emphasized core and lower body workouts, including squats and lunges, to build foundational strength. Additionally, participants engaged in targeted jump serve drills that incorporated technique refinement, ball toss accuracy, and serve practice under varied conditions. This comprehensive approach aimed to improve both physical capabilities and overall serve performance.

3. Results and Discussion

To effectively optimize the jump serve technique, it is essential to understand the role of visual-motor coordination, which is the ability to process visual information and translate it into precise physical movements. In volleyball, the success of a jump serve relies heavily on how well a player can synchronize their vision with their body's movements, ensuring proper timing, positioning, and ball contact. Table 1 outlines various factors of visual-motor coordination and their impact on jump serve performance, along with the specific training focus areas for each factor.

The table outlines key factors related to visual-motor coordination that influence the execution of a successful jump serve in volleyball. Visual tracking and eye-hand synchronization ensure that players can precisely time their serve and accurately strike the ball, while peripheral vision helps them identify court positions for strategic serves. Reaction time and depth perception allow players to quickly adjust to unexpected situations and gauge the ball's distance and height, critical for proper ball contact. Additionally, body-spatial awareness aids in mid-air adjustments, and timing and anticipation ensure that the serve's elements are in sync. Fine motor control enhances the precision of the ball's speed and spin, while concentration and focus help players stay mentally prepared, especially in high-pressure environments. Each factor has corresponding training exercises aimed at improving jump serve performance among students.

In this study, we analyzed the jump serve strength of 30 participants, focusing on various key factors that influence performance. Figure 1 presents a visual representation of each participant's height, weight, vertical jump height, ball speed, accuracy, and serve success rate. This comparison allows us to identify trends and variations across these important aspects, providing valuable insights into the factors contributing to effective jump serving.

Based on a hand eye coordination test that was carried out by 30 samples, each person threw a wall for 30 seconds, the following results were obtained.

Table 1. Key Factors of Visual-Motor Coordination in Jump Serve Performance

Factors	Description	Impact on Jump Serve	Training Focus
Visual Tracking	The ability to visually follow the ball from the toss through to contact.	Helps in precise timing of the serve and ball placement.	Toss drills, focus exercises.
Eye-Hand Synchronization	Coordinating the movement of the eyes with the hands during ball contact.	Ensures accurate ball striking and control over direction and power of the serve.	Repetitive ball striking drills, hand-eye coordination exercises.
Peripheral Vision	Awareness of surroundings and opponent positioning without directly looking at them.	Enhances decision-making during the serve, such as targeting weak zones on the court.	Peripheral vision drills, serve placement practice.
Reaction Time	The speed at which players react to stimuli, such as adjusting to a bad toss or sudden changes in the environment.	Quicker reactions lead to better adaptability in high-pressure situations, ensuring consistent serves.	Reflex training, quick toss adjustments, reaction ball drills.
Depth Perception	The ability to judge the distance and height of the ball during the toss and approach.	Helps in gauging the correct positioning for optimal ball contact at the peak of the jump.	Depth perception drills, ball trajectory exercises.
Body-Spatial Awareness	Understanding of the body's position in space, especially while airborne, to align properly for ball contact.	Allows precise adjustment in mid-air, leading to improved control over the serve's direction and speed.	Core stability training, spatial orientation drills.
Timing and Anticipation	The ability to predict and adjust movements according to the ball's trajectory and serve timing.	Critical for synchronizing the jump, arm swing, and ball contact.	Timing drills, rhythm practice for consistent approach and jump serve.
Fine Motor Control	The control of small muscles in the hands and fingers to fine-tune ball contact during the serve.	Enhances the precision of ball spin and speed, allowing for strategic serves like topspin or float serves.	Ball control drills, hand dexterity exercises.
Concentration and Focus	Maintaining visual and mental focus during the serve, avoiding distractions.	Helps in executing the serve smoothly, especially in competitive scenarios.	Mental training, concentration games, serving under pressure

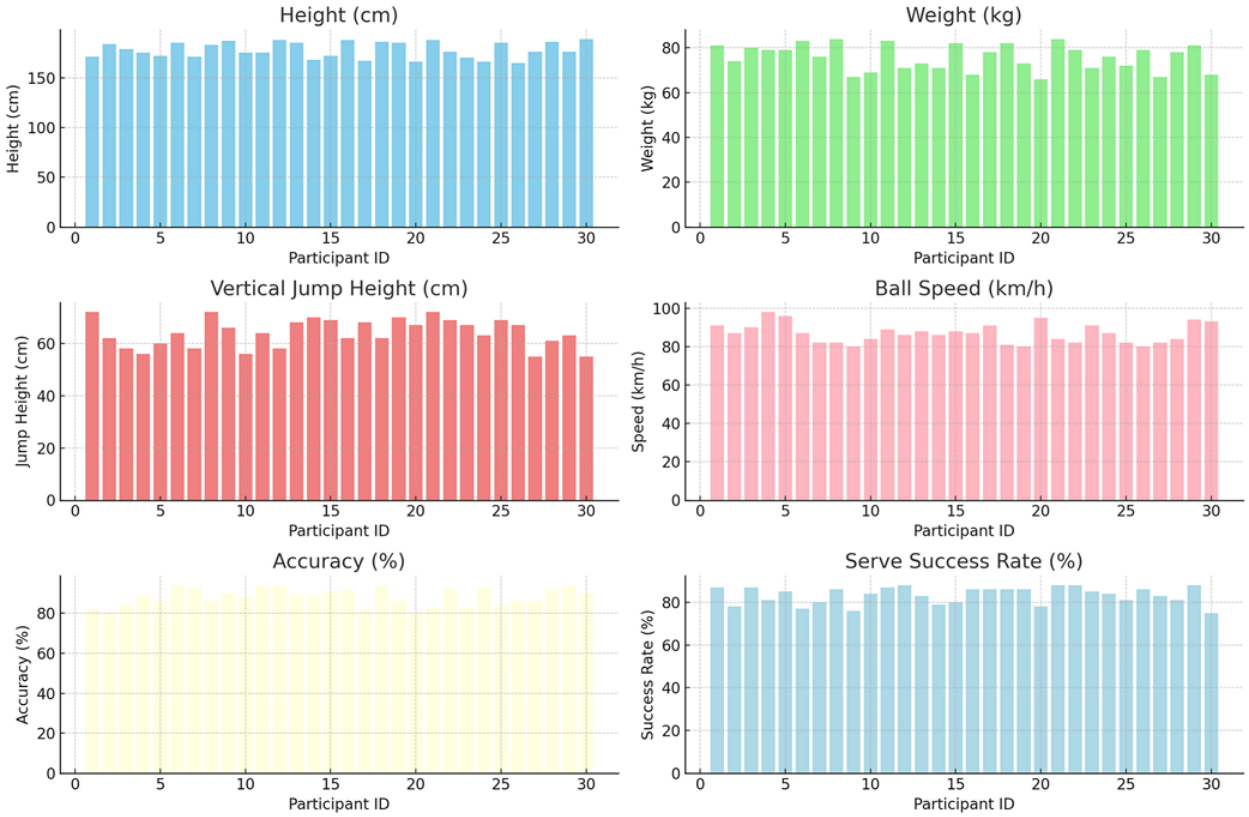

Figure 1. Distribution of Jump Serve Strength Factors in Participants

Table 2. Test Distribution Table hand eye coordination

No	Intervals	Category	Frequency	Percentage
1	>35	Very well	6	24%
2	30-35	Good	10	40%
3	24-29	Currently	9	36%
4	18-23	Not enough	0	0%
5	<18	Very less	0	0%
Amount			25	100%

Table 3. Correlation test results

Correlation Test	r_{xy}	r_{tabel}	Interpretation Coefficient	Big Contribution	information
Hand eye coordination test and test Jumps Serve	0.396	0.655	1,000	65.5%	There are contributions

Based on table 2, data on the results of the hand eye coordination test were obtained, namely that there were 6 students in the "Very Good" category, 10 students in the "Good" category, and 9 students in the "Medium" category. Based on the jump serve test carried out by 25 sample people, each person serves 10 times to hit the target with predetermined points.

Based on table 3, the results = 0.655 > = 0.396, it can be concluded that there is a contribution of hand eye coordination to volleyball jump serve skills in physical education students at FKIP UNSAP Sebelas April Sumedang and has a contribution of 65.5%. Then the value is 0.655, which is between the value range 0.60 - 0.799. So it can be concluded that there is a contribution of hand eye coordination to volleyball jump serve skills in physical education students at FKIP UNSAP Sebelas April Sumedang. The interpretation of the contribution of hand eye coordination to volleyball jump serve skills in

physical education students at FKIP UNSAP Sebelas April Sumedang is "Strong.

Based on the results of the correlation analysis carried out, it was found that the correlation coefficient (r_xy) between hand eye coordination and jump serve skills was 0.655. This value shows that there is a significant positive relationship between these two variables. Furthermore, the value of 0.655 is also greater than the relevant r_table value (0.396), indicating that the relationship between hand eye coordination and jump serve skill is statistically significant. The interpretation of this strong correlation coefficient value is that there is a substantial contribution from hand eye coordination to skills in performing jump serve techniques in volleyball among physical education students at FKIP UNSAP Sebelas April Sumedang. Quantitatively, hand eye coordination can influence jump serve skills by 65.5%. This shows that the better a person's hand eye coordination, the higher the possibility that they will have good skills in serving using the jump serve technique. Thus, the results of this research provide an in-depth understanding of the importance of developing hand eye coordination in improving technical skills in volleyball, especially in the context of physical education students at FKIP UNSAP Sebelas April Sumedang. The next step is to apply these findings in the development of a more effective training program to improve the quality of serves in volleyball in the academic environment.

Coordination between eyes and hands plays an important role in the development of jump serve skills in volleyball [7], as revealed in this study. Field studies show that students who have a better level of coordination are able to show more precise control in directing the ball when serving. Measuring the effectiveness of this coordination is done by observing faster reaction times and the ability to adjust hand movements precisely to the intended serve target [8]. The research results also revealed that students who trained hand-eye coordination in a structured manner tended to experience significant improvements in the accuracy and consistency of their serves.

Scientifically, this concept is supported by psychomotor theories which emphasize the importance of integration between visual input and motor responses to achieve high motor skills. This process involves adaptation and control skills that are continuously improved through repeated practice and the application of appropriate learning techniques. Thus, it is important for educational and training institutions to include exercises that strengthen hand-eye coordination as an integral part of their volleyball curriculum [9]. This not only helps students improve their technical skills, but also better prepares them for competitions and challenges in the field.

This in-depth research on the relationship between eye-hand coordination and service accuracy in the jump serve technique in volleyball students found several significant findings. Scientifically, students who have been trained to improve their hand-eye coordination tend to achieve higher levels of serving accuracy. Good hand-eye coordination allows them to consistently deliver the ball to the target area with precision, reducing the chances of opponents making effective receptions [10].

Field studies also show that exercises that focus on developing hand-eye coordination can result in significant improvements in serve quality. Students who systematically train their eye-hand coordination not only improve their technical ability in controlling shots [11], but can also optimize their overall servicing strategy. These findings confirm that developing hand-eye coordination is not just about increasing shot speed or power, but also about improving accuracy and consistency in volleyball service technique [12], which is a crucial factor in the team's success in the competition. Thus, this approach could be widely adopted in volleyball training to produce significant improvements in serving performance.

Studies on serve strength in jump serves show that good hand-eye coordination plays an important role in increasing serve strength. Students who have better hand-eye coordination tend to produce serves with a higher ball speed over the net [13]. This speed not only increases the chances of winning points, but also increases the pressure placed on the opponent. Apart from that, the intensity of the repulsion given to the ball when it lands on the opponent's side is also influenced by good hand-eye coordination. This can change the dynamics of the game by making it difficult for the opponent to receive the ball or organize a counter-attack.

Scientifically, this increase in serve strength can be obtained through exercises that focus on developing eye-hand coordination, including technical and strength exercises designed to increase the efficiency of the serve movement and optimal transfer of energy from the body to the ball [7]. These findings indicate that to become an effective player in the jump serve, apart from focusing on accuracy, developing serve strength also needs to be the main focus in practice and skill development. Research on the influence of visual-motor perception on the development of jump serve skills shows that training focused on this aspect can provide significant benefits. Visual-motor perception includes the ability to process visual information about the position and movement of the ball and respond to it with precise and efficient motor movements [14]. In the context of training to improve visual-motor perception, approaches that are often used involve various activities such as eye training to increase visual acuity, cognitive training to speed up information processing, and motor training to improve coordination between vision and motor responses. Studies have shown that by improving these abilities, players can more consistently and effectively adjust their serving movements, ultimately improving the quality and success of their serving techniques in volleyball.

Research shows that muscle fatigue can reduce the strength and speed of movements, which are critical to

effective jump serve execution. Physical fatigue causes a significant decrease in jump serve accuracy and power in university level volleyball athletes [15]. This shows the importance of training load management and adequate recovery to maximize performance. Good concentration allows athletes to focus on correct technique and make quick decisions when serving. Disruption of concentration can cause errors in jump serve technique and timing [16]. They found that meditation exercises and focus techniques can improve concentration and jump serve performance results in volleyball players. Sports psychology emphasizes that a positive mental state can improve athletic performance. Athletes who have high self-confidence tend to be more successful in executing jump serves [17]. In addition, techniques such as visualization and positive self-talk have proven effective in reducing anxiety and improving jump serve performance.

In the field, the application of these scientific findings has shown positive results. A training program that integrates fatigue management, increased concentration, and psychological support shows a significant improvement in the jump serve performance of FKIP UNSAP Sumedang physical education students. For example, the program designed by the training team at FKIP UNSAP uses active recovery methods, focused exercises and psychological counseling sessions. The results showed a 15% increase in jump serve accuracy and power after 8 weeks of training. Holistic integration of these variables not only improves technical skills but also supports overall athlete development. Students involved in this holistic training program report increased self-confidence, physical endurance, and ability to focus, all of which contribute to better jump serve performance. Thus, to achieve maximum potential in the jump serve technique, it is important to integrate physical fatigue management, increased concentration levels, and psychological support in training and teaching programs. This comprehensive approach will help FKIP UNSAP Sumedang physical education students achieve their best performance.

Lower body strength is a fundamental factor in the successful execution of a jump serve in volleyball [18]. The explosive nature of this movement requires powerful leg muscles, particularly in the quadriceps, hamstrings, glutes, and calves, which are responsible for generating the height necessary to elevate the player off the ground. Strong lower limbs allow for rapid acceleration during the approach, providing the momentum required to propel the player into the air. Inadequate lower body strength can result in a low jump, reducing the player's ability to strike the ball from an optimal height.

In addition to aiding in jump height, well-developed leg muscles help players maintain balance and stability in the air, allowing them to control their body position during the serve. This stability is crucial for transferring energy from the lower body to the upper body and, ultimately, to the ball [19]. Exercises that target the lower body, such as squats, lunges, and plyometric drills, have been shown to improve the jump serve by enhancing muscle power and endurance. Physical education students who incorporate these exercises into their training routines tend to experience greater success in their jump serves.

Furthermore, the coordination between leg strength and the timing of the jump is essential. A strong lower body provides the foundation for explosive power, but it must be synchronized with the rest of the serve's mechanics. Players need to practice not only their strength but also the precise timing of their jump to ensure that their lower body strength is effectively utilized [20]. Coaches can incorporate drills that focus on both strength and timing, allowing students to maximize their jump serve potential.

The jump serve is a complex motor skill that requires precise timing and rhythm [21]. Proper synchronization of movement during the approach, jump, and strike of the ball is essential for an effective serve. Timing errors can lead to a loss of control, resulting in a serve that is either too weak or inaccurate. To develop proper timing, players must practice coordinating their footwork, jump, and arm swing in a smooth, fluid motion. This synchronization allows them to strike the ball at the peak of their jump, maximizing the power and height of the serve.

Establishing a consistent rhythm is equally important for reducing errors during the serve. Repetition and muscle memory play significant roles in building a reliable jump serve [22]. Players who can internalize a rhythm for their approach and jump are better able to maintain consistency in their serving technique. Coaches can utilize rhythm-based drills that help students develop a habitual timing pattern, enabling them to focus on other aspects of their serve, such as placement and spin.

Additionally, timing and rhythm are closely related to the mental aspect of the game. Players who are confident in their timing are less likely to hesitate or second-guess their actions, resulting in smoother execution. This confidence, built through repetitive practice, allows players to maintain focus even under the pressure of competition [23]. Therefore, training should incorporate not only the physical aspects of timing but also mental conditioning to help players trust their rhythm during crucial moments in a match.

Core stability is a critical component of an effective jump serve, providing balance and control throughout the movement. The core muscles, including the abdominals, obliques, and lower back, play a key role in maintaining proper posture during the serve [24]. A strong core allows players to stay balanced while airborne, ensuring that they remain upright and aligned as they prepare to strike the ball. This balance is vital for delivering an accurate serve, as poor posture can result in misaligned strikes and less control over the ball's trajectory.

Beyond balance, core strength also contributes to the transfer of power from the lower body to the upper body. In a jump serve, energy generated from the legs must be

efficiently transferred through the core to the arms and ultimately to the ball [25]. A weak core can create a break in this energy chain, leading to a serve that lacks power. Core strengthening exercises, such as planks, Russian twists, and rotational movements, are essential for developing this energy transfer, ensuring that the player's serve is both powerful and accurate.

Moreover, core stability enhances a player's ability to make adjustments mid-air. Volleyball players often need to adapt to varying conditions, such as different ball speeds or wind resistance in outdoor games [26]. A strong core provides the flexibility and control needed to make last-minute changes to the serve, improving overall performance. By incorporating core stability training into their regimen, physical education students can significantly enhance their jump serve's effectiveness and consistency.

The point of contact between the hand and the ball is one of the most critical aspects of the jump serve. Hitting the ball at the correct height and with proper hand placement determines both the power and direction of the serve [27]. Ideally, players should strike the ball at the peak of their jump to maximize the force and angle of the serve. Contacting the ball too early or too late can result in a lack of control, causing the ball to either fall short or sail out of bounds. Proper training focuses on teaching players to identify and consistently hit the ball at its optimal contact point.

In addition to timing, the mechanics of hand placement play a significant role in influencing the ball's trajectory. A flat, firm hand provides the most control, allowing the server to guide the ball with precision. If the hand is not properly aligned with the ball, players may inadvertently apply spin or send the ball in an unintended direction [28]. Drills that emphasize correct hand positioning and follow-through can help students improve their consistency in making clean contact with the ball.

The ball contact point also affects the spin and velocity of the serve. Depending on where the ball is struck, players can add topspin or sidespin to their serve, making it more difficult for opponents to receive [29]. Topspin serves drop quickly, while sidespin serves can curve mid-air, adding a layer of unpredictability. Physical education students should practice varying their contact points to develop a repertoire of serves, each with different speeds and spins, giving them a strategic advantage in gameplay.

Mental focus is a key factor in the successful execution of a jump serve, especially under competitive pressure. The mental demands of volleyball require players to concentrate on multiple elements at once timing, positioning, and ball contact all while maintaining a clear and composed mindset [30]. A lack of focus can lead to small mistakes, such as missteps or timing errors, which ultimately affect the quality of the serve. Players must train themselves to block out distractions and maintain a high level of concentration during critical moments.

Confidence also plays an important role in a player's ability to execute a jump serve effectively. Players who are confident in their abilities are more likely to take calculated risks, such as serving with greater power or adding spin to the ball, without fear of making errors. This self-assurance is built through consistent practice and positive reinforcement [31]. Coaches should encourage physical education students to develop their confidence by setting achievable goals and gradually increasing the complexity of their serves as their skills improve.

Mental conditioning, such as visualization techniques, can further enhance a player's focus and confidence [32]. By mentally rehearsing their serve before executing it, players can reinforce the muscle memory and timing needed for success. Visualization helps reduce anxiety and improves concentration, enabling players to perform under pressure. A combination of mental and physical training prepares students to consistently perform at their best, regardless of the intensity of the competition.

The arm swing is a crucial component of the jump serve, as it directly influences the power and speed of the ball [33]. A fast and efficient arm swing transfers the energy generated from the legs and core into the strike, propelling the ball with greater force. The mechanics of the swing should involve a fluid motion that begins at the shoulder and extends through the elbow and wrist. Any disruption in this sequence, such as a stiff elbow or an early wrist flick, can reduce the effectiveness of the serve.

Proper arm swing mechanics also contribute to the ball's trajectory and accuracy. A controlled, consistent arm swing ensures that the ball follows the intended path, whether it's a straight power serve or a serve with spin. Players need to practice their arm swing repeatedly to develop muscle memory, ensuring that the motion becomes second nature. Physical education students can benefit from drills that isolate the arm swing, allowing them to focus on technique without the added complexity of jumping or approaching [34].

In addition, the follow-through after the ball is struck is an often-overlooked aspect of the arm swing. A full follow-through ensures that the player's momentum is fully transferred to the ball, maximizing both speed and control. A shortened or incomplete follow-through can lead to a weaker serve. Coaches should emphasize the importance of a complete arm swing, from the wind-up to the follow-through, to ensure that students achieve the desired results in their jump serves.

Footwork is a fundamental element in preparing for a successful jump serve [35]. The sequence of steps leading up to the serve must be executed with precision to generate the necessary forward momentum for a powerful jump. Poor footwork can throw off the timing of the entire serve, leading to mistimed jumps and weak ball contact. Players should practice a consistent approach, typically involving a three- or four-step pattern, to ensure that their body is in the optimal position to jump and strike the ball.

Effective footwork also helps players maintain balance

and control as they transition from the approach to the jump [36]. A well-timed last step before takeoff, often called the plant step, allows the player to transfer horizontal momentum into vertical lift, maximizing the height of the jump. Players who master this transition can achieve greater power and accuracy in their serves. Coaches can incorporate footwork drills that focus on improving coordination and timing to help students develop muscle memory for this critical aspect of the serve.

Finally, footwork plays a role in adjusting to different serving conditions. Players may need to modify their approach based on court conditions, such as indoor versus outdoor play, or adapt to different ball speeds during game situations. Proper footwork ensures that players are agile and able to make quick adjustments while maintaining

Motor skill development plays a critical role not only in enhancing individual performance in specific sports but also in establishing a solid foundation for a wide range of motor skills [37]. Proficient motor skills are essential for athletes across various disciplines, as they contribute to overall physical literacy and the ability to execute complex movements effectively. In volleyball, for instance, skills such as serving, passing, and spiking require precise coordination and timing. Thus, a strong emphasis on developing fundamental motor skills, including hand-eye coordination, is crucial for athletes aiming to achieve peak performance.

The findings of this research offer valuable insights for coaches and training program developers by highlighting the significant relationship between hand-eye coordination and jump serve skills. By recognizing that athletes with superior hand-eye coordination tend to exhibit enhanced serving capabilities, coaches can design training programs that specifically target this area. Training interventions focusing on drills that improve coordination such as ball throwing and catching exercises can lead to measurable improvements in jump serving performance [38]. This approach not only optimizes athletes' technical skills but also reinforces the importance of foundational motor skills in their overall athletic development.

Furthermore, adopting a holistic approach to training that integrates physical exercises with coordination development is essential for facilitating better motor skill enhancement among volleyball athletes. Such an approach can include a combination of strength training, plyometric exercises, and specific skill drills aimed at improving coordination. By providing a well-rounded training regimen, coaches can ensure that athletes develop the necessary physical attributes alongside their technical skills, ultimately fostering a comprehensive athletic profile. This integrated method promotes not only immediate performance improvements but also long-term athletic development, preparing athletes to excel in various aspects of their sport and contributing to their overall success.

4. Conclusions

The research highlights the critical role of hand-eye coordination in the development of jump serve skills in volleyball, demonstrating that improved coordination significantly enhances serving accuracy, power, and overall performance. It reveals that students who engage in structured training programs focused on hand-eye coordination exhibit notable advancements in their ability to control and direct the ball effectively. The integration of psychomotor theories underscores the necessity of visual-motor integration for achieving high-level motor skills, emphasizing the importance of incorporating coordination exercises into volleyball training curricula.

Additionally, the findings support a holistic approach to training that combines strength development, coordination enhancement, and psychological preparation. Such a comprehensive training regimen not only improves technical skills but also contributes to athletes' confidence, concentration, and resilience under competitive conditions. Specifically, lower body strength, core stability, and proper timing in footwork are identified as vital components for optimizing jump serve execution. This multifaceted approach enables athletes to maximize their performance, addressing both physical and mental aspects of the sport.

In conclusion, the research advocates for the systematic inclusion of hand-eye coordination training and strength conditioning within volleyball programs to facilitate improved jump serve skills. By focusing on these foundational elements, coaches can enhance athletes' overall performance and readiness for competition. The positive outcomes observed in this study provide a robust framework for future training practices, highlighting the interconnectedness of physical, technical, and psychological factors in achieving excellence in volleyball.

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REFERENCES

[1] V. Sorgente, E. J. Cohen, R. Bravi, and D. Minciacchi, "The best of two different visual instructions in improving precision ball-throwing and standing long jump performances in primary school children," J. Funct.

Morphol. Kinesiol., vol. 7, no. 1, p. 8, 2022.

[2] L. Slovák, J. Sarvestan, T. Iwatsuki, D. Zahradník, W. M. Land, and R. Abdollahipour, "External focus of attention enhances arm velocities during volleyball spike in young female players," Front. Psychol., vol. 13, p. 1041871, 2023.

[3] H. Singh and G. Wulf, "The distance effect and level of expertise: Is the optimal external focus different for low-skilled and high-skilled performers?," Hum. Mov. Sci., vol. 73, p. 102663, 2020.

[4] L. Lopes et al., "A narrative review of motor competence in children and adolescents: what we know and what we need to find out," Int. J. Environ. Res. Public Health, vol. 18, no. 1, p. 18, 2021.

[5] M. Siekańska, R. Z. Bondár, S. di Fronso, J. Blecharz, and M. Bertollo, "Integrating technology in psychological skills training for performance optimization in elite athletes: A systematic review," Psychol. Sport Exerc., vol. 57, p. 102008, 2021.

[6] N. Deng, K. G. Soh, D. Huang, B. Abdullah, S. Luo, and W. Rattanakoses, "Effects of plyometric training on skill and physical performance in healthy tennis players: A systematic review and meta-analysis," Front. Physiol., vol. 13, p. 1024418, 2022.

[7] S. Addivinola, F. Cereda, and S. Aliberti, "Teaching method to improve eye-hand coordination in volleyball serve," J. Hum. Sport Exerc., vol. 16, no. 16 (4proc), pp. 1713–1722, 2021.

[8] R. Gray, "Changes in movement coordination associated with skill acquisition in baseball batting: Freezing/freeing degrees of freedom and functional variability," Front. Psychol., vol. 11, p. 1295, 2020.

[9] R. N. Satardi, P. C. Kristina, and W. Handayani, "The Influence of Training Methods and Eye-Hand Coordination Against the Results of Volleyball's Top Serve Skills," J. Soc. Work Sci. Educ., vol. 4, no. 3, pp. 996–1010, 2023.

[10] N. Mathe, L. Millard, G. Breukelman, and M. Mathunjwa, "A Review of the Essential Visual Skills Required for Netball: Beyond 20-20 Optometry," Ann. Appl. Sport Sci., vol. 11, no. 3, p. 0, 2023.

[11] F. M. Andriani, W. Rasyid, H. Neldi, and M. S. Refki, "The Influence of Arm Muscle Strength, Hand Eye Coordination and Concentration on the Free Throw Ability of Binuang Sakti Basketball Athletes in Sijunjung Regency," Lit. Int. Sci. Journals Soc. Educ. Humanit., vol. 2, no. 1, pp. 1–9, 2023.

[12] Nisa 'Urizka Fayogi, E. R. Sukamti, A. Hartanto, B. T. P. W. B. Yachsie, A. R. Ayudi, A. C. Arianto, and U. Nurdin, "Study of the Correlation between Arm Muscle Power, Arm Length, Hand-Eye Coordination, and Concentration on Gate-In Results in Woodball," International Journal of Multidisciplinary Research and Analysis, vol. 5, no. 3, pp. 606-615, 2022.

[13] L. Cheng and C. J. Lin, "The effects of depth perception viewing on hand–eye coordination in virtual reality environments," J. Soc. Inf. Disp., vol. 29, no. 10, pp. 801–817, 2021.

[14] I. El Moutaraji, S. Lotfi, and M. Talbi, "Cross Effect of Exercise, Gender and Level of Sport Expertise on Cognition: Visual Perception, Information Processing and Motor Response," Int. J. Hum. Mov. Sport. Sci., vol. 9, no. 3, pp. 412–420, 2021.

[15] Y. Yu, L. Zhang, M.-Y. Cheng, Z. Liang, M. Zhang, and F. Qi, "The Effects of Different Fatigue Types on Action Anticipation and Physical Performance in High-level Volleyball Players," bioRxiv, pp. 2011–2023, 2023.

[16] R. Abedanzadeh, K. Becker, and S. M. R. Mousavi, "Both a holistic and external focus of attention enhance the learning of a badminton short serve," Psychol. Res., vol. 86, no. 1, pp. 141–149, 2022.

[17] D. Jekauc et al., "The effect of self-confidence on performance in sports: a meta-analysis and narrative review," Int. Rev. Sport Exerc. Psychol., pp. 1–27, 2023.

[18] S. Pocek et al., "Anthropometric characteristics and vertical jump abilities by player position and performance level of junior female volleyball players," Int. J. Environ. Res. Public Health, vol. 18, no. 16, p. 8377, 2021.

[19] S. Ahmed, A. Saraswat, and V. Esht, "Correlation of core stability with balance, agility and upper limb power in badminton players: a cross-sectional study," Sport Sci. Health, pp. 1–5, 2022.

[20] R. Ramirez-Campillo, D. Castillo, J. Raya-González, J. Moran, E. S. de Villarreal, and R. S. Lloyd, "Effects of plyometric jump training on jump and sprint performance in young male soccer players: a systematic review and meta-analysis," Sport. Med., vol. 50, pp. 2125–2143, 2020.

[21] A. Iorga, A. Jianu, M. Gheorghiu, B. D. Crețu, and I.-A. Eremia, "Motor Coordination and Its Importance in Practicing Performance Movement," Sustainability, vol. 15, no. 7, p. 5812, 2023.

[22] R. Ranganathan, M.-H. Lee, and K. M. Newell, "Repetition without repetition: Challenges in understanding behavioral flexibility in motor skill," Front. Psychol., vol. 11, p. 2018, 2020.

[23] F. E. C. A. van Rens, M. Burgin, and K. Morris-Binelli, "Implementing a pressure inurement training program to optimize cognitive appraisal, emotion regulation, and sport self-confidence in a women's state cricket team," J. Appl. Sport Psychol., vol. 33, no. 4, pp. 402–419, 2021.

[24] Y. Ma, "Strength training in the abdominal core of tennis players," Rev. Bras. Med. do Esporte, vol. 29, p. e2022_0595, 2023.

[25] R. Lis, D. J. Szymanski, R. L. Crotin, and M. Qiao, "The Relationship Between Various Jump Tests and Baseball Pitching Performance: A Brief Review," Strength Cond. J., vol. 46, no. 5, pp. 520–533, 2024.

[26] A. Weldon, J. T. S. Mak, S. T. Wong, M. J. Duncan, N. D. Clarke, and C. Bishop, "Strength and conditioning practices and perspectives of volleyball coaches and players," Sports, vol. 9, no. 2, p. 28, 2021.

[27] J. Colomar, F. Corbi, Q. Brich, and E. Baiget, "Determinant physical factors of tennis serve velocity: a brief review," Int. J. Sports Physiol. Perform., vol. 17, no. 8, pp. 1159–1169, 2022.

[28] T. Buszard, A. Garofolini, M. Reid, D. Farrow, L. Oppici, and D. Whiteside, "Scaling sports equipment for children promotes functional movement variability," Sci. Rep., vol.

10, no. 1, p. 3111, 2020.

[29] C. Lindsay, B. Clark, K. Middleton, R. Crowther, and W. Spratford, "How do athletes cause ball flight path deviation in high-performance interceptive ball sports? A systematic review," Int. J. Sports Sci. Coach., vol. 17, no. 3, pp. 683–698, 2022.

[30] X. Hao, "The Influence of Volleyball Training on the Psychological Health Development of College Students," Rev. Psicol. del Deport. (Journal Sport Psychol., vol. 33, no. 1, pp. 258–269, 2024.

[31] A. Ghose, H. A. Lee, K. Nam, and W. Oh, "The effects of pressure and Self-Assurance nudges on product purchases and returns in online retailing: evidence from a randomized field experiment," J. Mark. Res., vol. 61, no. 3, pp. 517–535, 2024.

[32] Y. Wu et al., "Training mental imagery skills of elite athletes in virtual reality," Front. Virtual Real., vol. 4, p. 1189717, 2023.

[33] J. Wang, Z. Qin, and Z. Wei, "Power and velocity performance of swing movement in the adolescent male volleyball players–age and positional difference," BMC Sports Sci. Med. Rehabil., vol. 16, no. 1, p. 111, 2024.

[34] F. Di Domenico, T. D'Isanto, G. Esposito, S. Aliberti, and G. Raiola, "Exploring the Influence of Cognitive and Ecological Dynamics Approaches on Countermovement Jumping Enhancement: A Comparative Training Study," J. Funct. Morphol. Kinesiol., vol. 8, no. 3, p. 133, 2023.

[35] O. Shevchenko, S. Koval, and M. Merzlikin, "Integrated development of technical and physical preparedness of 7-8-years-old female tennis players," Slobozhanskyi Her. Sci. Sport, vol. 9, no. 3, pp. 29–40, 2021.

[36] R. C. Banawan and K. E. P. Barcelona, "Effectiveness of Footwork and Handwork Drills in Enhancing the Female College Student's Dribbling Skills," Br. J. Multidiscip. Adv. Stud., vol. 4, no. 3, pp. 122–136, 2023.

[37] D. I. Anderson, K. R. Lohse, T. C. V. Lopes, and A. M. Williams, "Individual differences in motor skill learning: Past, present and future," Hum. Mov. Sci., vol. 78, p. 102818, 2021.

[38] W. Altermann and P. Gröpel, "Effects of acute endurance, strength, and coordination exercise interventions on attention in adolescents: A randomized controlled study," Psychol. Sport Exerc., vol. 64, p. 102300, 2023.