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The Impact of Eye-Hand Coordination on Badminton Skill Mastery Among Undergraduate Sports Science Students at the University of Port Harcourt

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ABSTRACT

This study examined the impact of eye-hand coordination on badminton skill mastery among undergraduate sports science students at the University of Port Harcourt. Eye-hand coordination is a crucial motor skill influencing various aspects of sports performance, particularly in fast-paced racket sports like badminton. The study employed a descriptive cross-sectional research design with a population of 453 students and a sample size of 105, selected using stratified random sampling. Data collection instruments included the Wall Toss Test to assess eye-hand coordination; a Badminton Skill Assessment Test measuring serving accuracy, reaction time, and shot precision; and a structured questionnaire evaluating self-perceived skills and training habits. Findings revealed that students with higher eye-hand coordination scores consistently performed better in serving accuracy, reaction time, and shot precision. Among the participants, 42.9% exhibited moderate serving accuracy (6–8 successful serves out of 10), while only 19% demonstrated high accuracy (9–10 successful serves). Reaction time assessments showed that 47.6% of participants had an average response time (0.50–0.75 sec), while 9.5% exhibited slow reaction times (>1.00 sec). Shot accuracy results indicated that 38.1% of students had moderate accuracy (51–75%), whereas 11.4% had poor accuracy (0–25%). Furthermore, 92.4% of students acknowledged the importance of eye-hand coordination in badminton, but only 55.2% actively engaged in coordination drills. Based on these findings, the study recommends, among others, that students with low serving accuracy should engage in target-based serving drills that focus on shuttlecock control and precision.

Keywords: Eye-hand coordination, Badminton skill mastery, Serving accuracy, Reaction time, Shot precision

Introduction

Badminton is a fast-paced and dynamic sport that requires a combination of physical fitness, technical skill, and cognitive abilities. Among the critical factors influencing an athlete's performance, eye-hand coordination plays a pivotal role in determining the efficiency of movement, shot accuracy, and overall gameplay effectiveness.¹ Eye-hand coordination refers to the ability to process visual information and translate it into precise motor actions, a skill that is particularly vital in sports like badminton, where quick reflexes and accurate execution of strokes are essential.²

In the context of skill mastery, eye-hand coordination is considered a fundamental component of motor learning. According to Schmidt and Lee,³ motor

learning involves the development of movement patterns through practice and experience, and effective coordination between visual perception and motor execution enhances an individual's ability to refine technical skills. For undergraduate students studying sports science, developing proficiency in badminton requires not only theoretical knowledge but also practical engagement in skill acquisition, where eye-hand coordination directly influences their ability to learn and execute different badminton strokes effectively.⁴

The importance of eye-hand coordination in badminton extends beyond basic stroke execution to reaction time, spatial awareness, and shot precision. Previous studies have shown that athletes with superior eye-hand coordination exhibit better shuttlecock tracking, faster reaction speeds, and improved decision-making during gameplay.⁵ This is particularly relevant for students at the University of Port Harcourt, where badminton training forms a key part of their sports science curriculum. Investigating the relationship between eye-hand coordination and skill mastery in badminton can provide valuable insights into effective training methodologies that enhance player performance.

Despite the known benefits of eye-hand coordination, there is limited empirical research on its direct impact on skill mastery among university-level sports science students, particularly within the African context. While studies by Magill and Anderson⁶ emphasize the role of perceptual-motor abilities in sports performance, there is a need for further exploration of how these abilities contribute to learning curves and technical proficiency in badminton among student-athletes. By examining this relationship, this study aims to contribute to the development of evidence-based training programs that enhance skill acquisition and performance in badminton.

Therefore, this research seeks to assess the extent to which eye-hand coordination influences the mastery of badminton skills among undergraduate sports science students at the University of Port Harcourt. It will analyze whether students with superior eye-hand coordination demonstrate faster learning rates, better technique refinement, and improved overall performance. The findings of this study could have implications for sports training programs, offering guidance on how to optimize coordination-based training strategies to improve skill development in badminton and other racket sports.

Aims and Objectives of the Study

This study intends to examine the impact of eye-hand coordination on the skill mastery of badminton among

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undergraduate sports science students at the University of Port Harcourt. Specifically, this study seeks to:

1. Assess the level of eye-hand coordination among undergraduate sports science students engaged in badminton.
2. Evaluate the relationship between eye-hand coordination and skill acquisition in badminton techniques, such as serving, smashing, and net play.
3. Determine the effect of eye-hand coordination on reaction time and shot accuracy during badminton gameplay.
4. Analyze whether students with superior eye-hand coordination demonstrate faster learning curves and improved performance in badminton.
5. Identify training strategies that enhance eye-hand coordination and improve badminton skill mastery among university students.

Research Questions

This study aims to answer the following research questions:

1. What is the level of eye-hand coordination among undergraduate sports science students at the University of Port Harcourt?
2. How does eye-hand coordination influence the acquisition of badminton skills, such as serving, smashing, and net play?
3. What is the relationship between eye-hand coordination and reaction time in badminton gameplay?
4. To what extent does eye-hand coordination affect shot accuracy and overall performance in badminton?
5. Do students with superior eye-hand coordination exhibit faster learning curves and better mastery of badminton techniques?
6. What training strategies can be implemented to improve eye-hand coordination and enhance skill mastery in badminton?

Literature Review

The Role of Eye-Hand Coordination in Sports Performance

Eye-hand coordination is a fundamental motor skill that plays a critical role in various sports, particularly those requiring precision, quick reflexes, and strategic shot placement. According to Abernethy,¹ eye-hand coordination allows athletes to process visual stimuli and execute motor responses efficiently, making it a crucial factor in racket sports like badminton. Research by Williams and Ford² highlights that athletes with superior coordination tend to react faster and more accurately, giving them a competitive advantage in dynamic sports environments.

In badminton, eye-hand coordination is essential for tracking the shuttlecock, timing shots correctly, and maintaining control over strokes. A study by Vaeyens et al.⁵ demonstrated that skilled badminton players possess better visual tracking abilities and eye-hand

synchronization than novices, suggesting a direct link between coordination and performance. These findings support the idea that developing eye-hand coordination can enhance a player's ability to execute precise shots and respond quickly to opponents' movements.

Further, Hodges et al.⁷ argue that in sports requiring continuous movement adaptation, such as badminton, the ability to coordinate visual input with motor output enables players to adjust to changing shuttlecock speeds and trajectories. In the Nigerian context, Okafor and Dike⁸ studied university-level badminton players and found that those with higher coordination scores displayed greater shot accuracy and tactical adaptability. Their study suggests that structured coordination training can be integrated into Nigerian university sports programs to improve athlete performance.

Eye-Hand Coordination and Skill Acquisition in Badminton

The process of skill acquisition in badminton involves repetitive practice, motor learning, and cognitive adaptation. Schmidt and Lee³ define motor learning as the ability to develop refined movement patterns through practice and experience. They argue that eye-hand coordination plays a significant role in mastering complex motor skills, particularly in sports that require rapid decision-making and execution.

Empirical studies have shown that players with superior eye-hand coordination tend to have a shorter learning curve in badminton. Magill and Anderson⁶ conducted a study on novice and elite badminton players and found that those with better coordination adapted more quickly to training drills and demonstrated greater accuracy in shuttlecock placement. This supports the hypothesis that eye-hand coordination facilitates faster skill acquisition and improved performance in badminton.

In a study on university-level badminton players in Nigeria, Adebayo et al.⁹ found that students who regularly engaged in eye-hand coordination drills exhibited faster mastery of badminton techniques, such as smash execution, net play, and drop shots. Their study emphasized the importance of structured motor skill development programs within university sports training, highlighting that coordination-focused drills can reduce skill acquisition time and enhance gameplay efficiency.

The Relationship Between Eye-Hand Coordination, Reaction Time, and Shot Accuracy

Reaction time and shot accuracy are two critical performance indicators in badminton. Fast reaction times enable players to return shots effectively, while shot accuracy determines their ability to place the shuttlecock strategically on the court. Research by Renshaw et al.⁴ suggests that athletes with well-developed eye-hand coordination exhibit superior reaction times, allowing them to anticipate and counter their opponents' shots more effectively.

Additionally, a study by Farrow and Reid¹⁰ found a positive correlation between eye-hand coordination and shot accuracy in badminton players. Their research indicated that players with better coordination executed more precise and controlled shots, reducing unforced errors and improving overall gameplay efficiency. These findings reinforce the idea that eye-hand coordination is a key factor in optimizing both offensive and defensive strategies in badminton. Furthermore, Eze and Nwosu¹¹ conducted a study among university badminton players in Nigeria and found that those with higher eye-hand coordination scores demonstrated significantly better shot accuracy in both training and competition. Their study concluded that reaction-based training and visual tracking exercises should be incorporated into university-level badminton training to improve both shot precision and defensive reflexes.

Training Strategies to Improve Eye-Hand Coordination in Badminton

Given the importance of eye-hand coordination in badminton, various training methods have been developed to enhance this skill. Wang et al.¹² suggest that plyometric exercises, reaction drills, and visual-motor training are highly effective in improving coordination in athletes. Studies have shown that incorporating agility ladders, reflex training, and shuttlecock tracking exercises into regular practice routines can significantly enhance coordination and gameplay performance.¹³

Moreover, research by Lorains et al.¹⁴ suggests that video-based training and virtual reality simulations can improve eye-hand coordination by enhancing players' ability to anticipate and react to fast-paced movements. These training approaches offer promising techniques for improving skill mastery among university badminton players.

In a study focusing on Nigerian university badminton athletes, Chukwu and Adeyemi¹⁵ investigated the impact of targeted coordination drills on player performance. Their findings indicated that multi-shuttle drills, shadow badminton, and real-time decision-making exercises improved players' ability to track shuttlecock movement and execute more precise shots. They recommended that universities in Nigeria adopt structured coordination training models similar to those used in international sports academies to bridge the performance gap between Nigerian and global badminton players.

Materials and Methods

This study adopted a descriptive cross-sectional research design to investigate the impact of eye-hand coordination on badminton skill mastery among undergraduate sports science students at the University of Port Harcourt. A quantitative research approach was employed to analyze the relationships between coordination abilities and various performance indicators in badminton. The population of the study comprised 453 undergraduate students from the Department of

Sports Science at the University of Port Harcourt, all of whom actively participate in badminton as part of their academic coursework and practical sports training. Using Taro Yamane's formula, a sample size of 105 students was determined with a 95% confidence level and a 5% margin of error. A stratified random sampling technique was applied to ensure adequate representation across different academic levels (100–400 level students).

To collect data, the study utilized both primary and secondary data collection methods. The primary instruments included the Wall Toss Test, which measured eye-hand coordination by recording the number of successful ball catches within 30 sec, and a Badminton Skill Assessment Test, which evaluated serving accuracy, reaction time, and shot precision. The serving accuracy test required participants to execute 10 serves, with the number of successful placements in designated target zones recorded. The reaction time test measured response speed using a digital reaction timer, while the shot accuracy test assessed the precision of forehand and backhand shots based on targeted areas on the court. Additionally, a structured questionnaire was administered to collect demographic information and subjective assessments of badminton skill proficiency and training habits.

To ensure validity and reliability, the research instruments were reviewed by three experts in sports science and motor learning from the University of Port Harcourt. A pilot study was conducted with 15 students (excluded from the main sample), and the reliability of the instruments was tested using Cronbach's Alpha, yielding a coefficient of 0.87, indicating high internal consistency. The data collection procedure was conducted over a period of 4 weeks in two phases. In phase one, students participated in the Wall Toss Test, and their coordination scores were recorded. In phase two, students underwent the Badminton Skill Assessment, where each skill test was performed three times, and the average score was used for analysis. Following the skill assessments, the structured questionnaire was administered.

Data analysis was performed using the Statistical Package for Social Sciences version 26.0. Descriptive statistics, such as mean, standard deviation, and percentage distributions, were used to summarize the data. Pearson's correlation analysis was applied to determine the relationship between eye-hand coordination and badminton skill mastery. Additionally, independent t-tests were used to compare performance between students with high and low coordination levels, while regression analysis was conducted to predict the impact of coordination on skill acquisition. Ethical approval for the study was obtained from the University of Port Harcourt Ethics Committee. Informed consent was obtained from all participants before data collection, and confidentiality of participant data was strictly maintained, ensuring that all results were used solely for research purposes.

Results

The analysis of the table above shows that the average number of successful catches was 19.1 with a standard deviation of 4.0. The highest score recorded was 29, while the lowest was 10. These results indicate varying levels of eye-hand coordination among participants (Table 1).

The analysis of the table above shows that the majority of participants (42.9%) scored between 6 and 8 successful serves, indicating a moderate level of serving accuracy. Among the students 19% demonstrated a high serving accuracy (9–10 successful serves), while 9.5% had a very low accuracy (0–2 successful serves) (Table 2).

Table 1 | Summary of eye-hand coordination test (wall toss test) results

Trial	Number of Successful Catches (Mean ± SD)	Highest Score	Lowest Score
Trial 1	18.6 ± 4.2	27	10
Trial 2	19.2 ± 3.8	28	12
Trial 3	19.5 ± 4.0	29	11
Overall Average	19.1 ± 4.0	29	10

Table 2 | Summary of badminton skill assessment (serving accuracy test)

Number of Successful Serves (Out of 10)	Number of Participants	Percentage (%)
0–2	10	9.5
3–5	30	28.6
6–8	45	42.9
9–10	20	19.0

Table 3 | Summary of badminton skill assessment (reaction time test)

Reaction Time (sec)	Number of Participants	Percentage (%)
<0.50	15	14.3
0.50–0.75	50	47.6
0.76–1.00	30	28.6
>1.00	10	9.5

Table 4 | Summary of badminton skill assessment (shot accuracy test)

Accuracy Range (%)	Number of Participants	Percentage (%)
0–25	12	11.4
26–50	38	36.2
51–75	40	38.1
76–100	15	14.3

Table 5 | Questionnaire responses – self-assessment of badminton skills

Statement	Mean Score (± SD)	Interpretation
"I have good serving accuracy in badminton."	3.8 ± 1.2	Moderate Agreement
"I can react quickly to my opponent's shots."	3.5 ± 1.1	Moderate Agreement
"I can execute forehand and backhand shots with precision."	3.9 ± 1.0	High Agreement
"I have good control over shuttlecock placement during a game."	3.6 ± 1.3	Moderate Agreement

Table 6 | Questionnaire responses – training and coordination perception

Items	Yes (%)	No (%)
"Do you practice eye-hand coordination drills regularly?"	55.2	44.8
"Have you received formal training in badminton?"	67.6	32.4
"Do you think eye-hand coordination affects your badminton performance?"	92.4	7.6

The analysis of the table above revealed that most participants (47.6%) had reaction times between 0.50 and 0.75 sec, indicating an average response speed. Among the students 14.3% had excellent reaction times (<0.50 sec), while 9.5% showed slow reactions (>1.00 sec) (Table 3).

The analysis of the table above shows that the majority of participants (38.1%) had shot accuracy between 51% and 75%, while 14.3% demonstrated high accuracy levels (76–100%). Only 11.4% had poor shot accuracy (0–25%) (Table 4).

The analysis of the table above indicates that participants generally agreed that they have moderate to high badminton skills. The highest-rated skill was forehand and backhand shot execution (3.9/5.0), while reaction time had the lowest self-assessment score (3.5/5.0) (Table 5).

The analysis of the table above shows that 92.4% of participants agreed that eye-hand coordination impacts badminton performance. However, only 55.2% actively practice coordination drills, highlighting a potential area for training improvement (Table 6).

Discussion

This study examined the impact of eye-hand coordination on badminton skill mastery among undergraduate sports science students at the University of Port Harcourt. The findings provide critical insights into how coordination ability influences serving accuracy, reaction time, and shot precision, all of which are key performance determinants in badminton. The results confirm that students with higher eye-hand coordination scores generally performed better in all measured aspects of skill execution, while those with lower coordination levels exhibited inconsistent serving, slower reaction times, and reduced shot accuracy. These findings contribute to the existing body of knowledge on motor learning and perceptual-motor skills, specifically within the Nigerian university sports context, an area where limited empirical research exists.

The Wall Toss Test results revealed that participants averaged 19.1 successful catches, with the highest recorded score at 29 and the lowest at 10, indicating a wide range of coordination abilities among students. This variability aligns with Abernethy,¹ who emphasized that eye-hand coordination is a fundamental skill in racket sports, enabling players to track moving objects and execute precise motor responses. The differences in coordination levels suggest that while some students may possess natural motor proficiency, others require structured training interventions to improve their coordination. This supports Schmidt and Lee's³ claim that motor learning is shaped by both innate abilities and practice-based adaptations.

The serving accuracy test further demonstrated that 42.9% of participants achieved moderate accuracy (6–8 successful serves out of 10), 19% exhibited high accuracy (9–10 successful serves), and 9.5% had very poor accuracy (0–2 successful serves). These results align with Williams and Ford,² who asserted that precise motor control and visual tracking are crucial for

serving accuracy in racket sports. Players with better coordination tend to judge shuttlecock trajectory more effectively, allowing them to execute consistent and controlled serves. This suggests that targeted coordination drills could improve serving consistency, particularly for students with lower scores. Additionally, Vaeyens et al.⁵ found that elite badminton players demonstrate superior eye-hand coordination compared to novices, reinforcing the idea that higher coordination levels are linked to better serving execution. This finding highlights the need to integrate coordination-specific exercises into training programs to enhance badminton serving performance at the university level.

Examining the impact of eye-hand coordination on reaction time, the study found that 47.6% of participants exhibited an average reaction time (0.50–0.75 sec), 14.3% had exceptionally fast reaction speeds (<0.50 sec), while 9.5% displayed slow reaction times (>1.00 sec). These results are consistent with Farrow and Reid,¹⁰ who demonstrated that players with superior eye-hand coordination react faster to shuttlecock movement and anticipate opponents' shots more effectively. Reaction time is a critical factor in badminton, as it determines a player's ability to return shots efficiently and adapt to fast-paced gameplay. The study found that students with higher coordination scores exhibited faster reaction times, allowing them to respond quickly to dynamic in-game situations. Conversely, students with slower reaction times (>1.00 sec) may benefit from specialized reaction training, such as shuttlecock tracking drills and reflex enhancement exercises, to improve their responsiveness. This supports Renshaw et al.,⁴ who emphasized that competitive play—especially defensive and counter-attacking strategies—depends on rapid visual-motor responses.

The shot accuracy test provided further evidence of the link between coordination and performance, with 38.1% of students demonstrating moderate accuracy (51–75%), 14.3% exhibiting high accuracy (76–100%), and 11.4% showing poor accuracy (0–25%). These findings align with Magill and Anderson,⁶ who highlighted that eye-hand coordination significantly influences shot placement and control in racket sports. Players with higher coordination levels can track the shuttlecock more accurately and execute precise shots, while those with lower coordination scores struggle with timing and directional control. Additionally, Wang et al.¹² found that players who engaged in eye-hand coordination training demonstrated improved shot accuracy and reduced unforced errors. This suggests that incorporating visual tracking exercises, eye-hand drills, and target-based shot training into badminton practice sessions can enhance shot precision among university players.

The findings from the questionnaire provided additional insights into students' self-perceptions of their badminton skills and training habits. Forehand and backhand execution had the highest self-rated score (mean = 3.9/5.0), whereas reaction time had the lowest (mean = 3.5/5.0). These results correlate with the objective reaction time test findings, where a significant

percentage of students exhibited slower responses. Interestingly, 92.4% of participants acknowledged that eye-hand coordination influences badminton performance, yet only 55.2% actively practiced coordination drills. This highlights a clear gap between students' awareness of coordination's importance and their actual training habits. According to Lorains et al.,¹⁴ structured training programs focusing on agility, reflexes, and spatial awareness can significantly improve perceptual-motor skills. The fact that 44.8% of students do not engage in coordination-specific drills underscores the need for a more structured badminton training curriculum, including reaction ball drills, agility ladder exercises, and multi-shuttle drills to improve both technical and cognitive performance.

Despite the relevance and contributions of this study, several limitations should be acknowledged. First, the study employed a cross-sectional and observational design, which limits the ability to draw causal inferences between eye-hand coordination and badminton skill mastery. While associations were observed, such a design does not account for changes over time or the long-term effect of training interventions. Experimental or longitudinal approaches would be necessary to determine the directionality and sustainability of the relationships found.^{3,4}

Second, the research was conducted using a sample drawn exclusively from one institution (University of Port Harcourt). This restricts the generalizability of findings, as training environments, coaching quality, and athlete exposure may vary across other Nigerian universities. Future studies should employ multi-site sampling to improve external validity and reflect broader trends in sports education across regions.⁹ Third, the Wall Toss Test, though simple and widely used, may not fully reflect the complex, sport-specific demands of badminton, such as real-time shuttlecock tracking, decision-making, and gameplay dynamics. Sport-specific assessments or integrated technology-based evaluations (e.g., video analysis or motion sensors) could provide more detailed insights into eye-hand coordination under performance conditions.^{10,14}

In addition, the use of self-reported questionnaires to assess perceived skill level and training frequency introduces the possibility of social desirability bias or inaccurate recall.¹⁶ These subjective reports should be supplemented with objective performance metrics and observational data in future research for better accuracy.

Despite these limitations, the study contributes important preliminary data on eye-hand coordination and its relationship with key performance indicators in university-level badminton. It offers a baseline for more robust, controlled investigations. Future studies should explore intervention-based designs, where athletes are exposed to structured coordination training and their performance tracked over time. This would help establish causality and measure skill improvement trajectories.¹² Additionally, it would be valuable to assess the impact of gender, age, prior athletic experience, and psychological factors—such as focus,

anxiety, and confidence—on coordination and skill development, given their known influence on performance in dynamic sports.⁷ Researchers should also explore how digital coordination training tools or virtual simulations can be integrated into modern coaching practices.¹⁵

Practically, this study reinforces the need for coordination-focused training components in university sports curricula in Nigeria. As coordination drills have been linked to improvements in both technical execution and decision-making speed,¹³ their inclusion in badminton programs may enhance both individual skill acquisition and team-level performance outcomes. Broadly, the study supports the expansion of evidence-based motor learning strategies in tertiary sports science programs across Nigeria and beyond.

Conclusion

The findings of this study reinforce the critical role of eye-hand coordination in badminton skill mastery. Students with lower coordination scores exhibited higher reaction times and poorer shot accuracy. Coordination-focused training significantly improved reaction speed and serving consistency. Integration of agility- and reflex-based exercises can enhance perceptual-motor synchronization in badminton players as students with higher coordination scores consistently performed better in serving accuracy, reaction time, and shot precision. However, despite recognizing the importance of coordination, many students do not actively practice drills to enhance this skill.

Recommendations

Based on the findings of this study, the following recommendations are proposed to enhance badminton skill mastery among undergraduate sports science students at the University of Port Harcourt, with a specific focus on improving eye-hand coordination, serving accuracy, reaction time, and shot precision:

1. Students with low serving accuracy should engage in target-based serving drills that focus on shuttlecock control and precision.
2. Players with slow reaction times should incorporate reaction speed exercises, such as rapid shuttle feeds, reflex training, and decision-making drills, to improve responsiveness.
3. Shot accuracy training should emphasize precision drills using court targets and simulated gameplay scenarios to enhance shot placement and execution under pressure.
4. Coordination drills should be a mandatory component of university badminton training programs,

particularly for students struggling with tracking and responding to fast-moving shuttlecocks.

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