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Enhancing the Striking Angle of Inside-Foot Passes: An Educational Approach for Fifth and Sixth-Grade Students

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Abstract: *This study investigates the impact of structured training programs on improving the striking angle of inside-foot passes among fifth and sixth-grade students. The research contextualizes its findings within the broader scientific literature on biomechanics, motor learning, and youth sports development. Forty students aged 10–12 participated in a six-week intervention, divided into experimental and control groups. The intervention incorporated targeted exercises, bilateral play, and biomechanical analysis using Kinovea software. Statistical analysis revealed significant improvements in the experimental group (p=0.00). This study underscores the necessity of structured pedagogical approaches in physical education to enhance technical skill acquisition and recommends further research on long-term effects and advanced biomechanical assessments.*

Keywords: *striking angle, technical complexes, Kinovea, football, biomechanics.*

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Introduction

Football is not only the most popular sport globally but also serves as an essential component of physical education programs in schools (Popescu et al., 2023). Its dynamic nature promotes physical fitness, teamwork, discipline, and social interaction among students (Chunoh et al., 2020). Within the vast array of skills required in football, techniques such as the inside-foot pass are fundamental to effective game-play (Fatmala et al., 2024). Mastering this skill is crucial as it can significantly impact a player's contribution to their team and enhance their overall enjoyment of the sport (Setyawan, 2024; Alesi et al., 2022). This research's purpose is to discover the outcomes of specific exercises and instructional strategies targeted at improving the striking angle for the inside foot pass among fifth and sixth-grade students.

Recent observations highlighted the reality that many young players, particularly those in the formative years of football, ages 10 to 12, often exhibit neglect towards the development of essential techniques, such as the inside-foot pass (Teoldo et al., 2021). This neglect can result in a lack of effective performance during games and ultimately diminish the overall enjoyment of the sport for these young athletes (de León Rodríguez et al., 2024). Mastery of the inside-foot pass is critical for facilitating accurate and powerful passes, which can lead to successful plays and greater team cohesion (Săndoi et al., 2023).

Through this research, we will explore how targeted training interventions influence students' ability to execute this crucial skill efficiently. By assessing the changes in performance before and after a structured training program, this study aims to establish whether a systematic approach to teaching football techniques can lead to significant improvement in students' skill levels (Krustrup et al., 2016).

The study encompasses a variety of exercises specifically designed to enhance the mechanics of passing with the inside foot. Evaluating students' performance in a controlled environment allows us to measure the effectiveness of these training methods quantitatively (Caracaleanu & Caracaleanu, 2019). This investigation is not solely about improving athletic performance; it also provides insights into effective pedagogical strategies in physical education (Li & Mateos, 2022).

This research is timely, considering the growing emphasis on youth sports development and the importance of foundational skills in children's physical education programs.

Literature review

Football passing mechanics have been extensively studied, with researchers emphasizing joint coordination, muscle activation, and biomechanical efficiency. Kellis & Katis (2007) highlight the importance of joint synchronization in executing powerful and accurate passes. Similarly, Tamura et al. (2023) found that proprioceptive training significantly enhances movement efficiency and passing accuracy.

Nunome et al. (2006) analyzed the segmental dynamics of side-foot and instep kicks, concluding that proper balance and stability significantly impact passing precision. Lees et al. (2009) further investigated pelvic motion and its effect on soccer kicking accuracy, revealing that stabilizing the pelvis during foot contact enhances pass consistency. Ahsan (2018) examined angular kinematics in soccer kicks, concluding that optimized striking angles lead to greater passing efficiency.

Additional studies have explored the pedagogical aspects of football training. Krustrup et al. (2016) emphasized the role of small-sided games in improving technical skill acquisition, while Li & Mateos (2022) discussed the influence of structured youth training on player development. Collectively, these studies highlight the need for scientifically designed interventions to refine technical execution in youth footballers.

Moreover, recent advancements in biomechanical research indicate that the use of motion analysis software, such as Kinovea, provides valuable insights into movement efficiency, allowing for precise adjustments in training programs (Carlsson et al., 2019). Teoldo et al. (2021) advocate for the integration of real-time video analysis in coaching methodologies, emphasizing that it facilitates better player awareness and skill refinement. In addition, Săndoi et al. (2023) highlight that targeted interventions, such as repetition-based drills and biomechanical feedback, significantly improve motor learning and execution in football-specific skills.

By synthesizing these studies, it becomes evident that targeted biomechanical training is essential for refining the inside-foot pass technique. This study builds on these foundations by implementing a structured training regimen specifically designed to enhance striking angles and overall passing accuracy among young players.

Methodology

Forty students aged 10–12 participated in the study, equally divided into experimental and control groups. Gender balance was maintained to mitigate physiological differences in performance. Participants were screened

for prior football experience, and baseline assessments included anthropometric measurements (height and weight).

Baseline assessments were conducted to measure passing accuracy using Kinovea software, a tool for biomechanical motion analysis. Kinovea software enabled precise tracking of foot positioning, impact angles, and pass trajectory, providing quantitative insights into technical performance. The experimental group underwent a structured six-week training intervention, while the control group engaged in standard physical education activities.

The training intervention included:

- **Wall Passes:** Enhancing passing consistency through repetitive ball contact with a wall.
- **Partner Drills:** Reinforcing accuracy and ball control through paired passing exercises.
- **Dynamic Target Passing:** Simulating in-game scenarios with moving targets to improve precision.
- **Small-Sided Games:** Encouraging real-time decision-making and skill application in a competitive setting.

Post-intervention assessments mirrored initial evaluations to measure improvements in striking angles and passing accuracy.

The study was approved by an institutional ethics committee. Parental consent and participant assent were obtained, ensuring ethical compliance. Participants were informed of their right to withdraw without consequence. Data confidentiality and safety protocols were maintained throughout the study.

Additionally, the study complied with the ethical guidelines established by international sports research bodies. The data collection process was conducted with minimal intrusion, ensuring that participants' privacy was respected. All recorded footage used for motion analysis was anonymized before analysis.

Findings

Normal distribution of data test was verified through the Shapiro-Wilk test. Results indicated that the data were normally distributed, as the p-value for all variables exceeded 0.05.

Table 1 – Results of the paired sample t-test for each of the groups (E.G. and C.G.) between the initial (I.M.) and final (F.M.) measurements

	Mean	N	S.D.	t	df	p
Striking Angle E.G. F.M.	1.81°	20	1.02	-8.00	19	0.00
Striking Angle E.G. I.M.	5.40°	20	1.70			
Striking Angle C.G. F.M.	5.99°	20	3.97	0.92	19	0.37
Striking Angle C.G. I.M.	5.09°	20	1.75			

A paired samples t-test was performed to compare the Striking Angle values between the initial and final E.G. measurement conditions. A statistically significant difference was found between the values of Striking Angle E.G. I.M. (M=5.40°, SD=1.70) and Striking Angle E.G. F.M. (M=1.81°, SD=1.02); t(19)=-8.00, p=0.00. These results suggest that drills, technical complexes and bilateral thematic play had a significant impact on improving lats striking angle from baseline to final measurements.

We performed the same paired samples t-test to compare the hitting angle values between the baseline and final C.G. measurement conditions. There was no statistically semi-significant difference between the C.G. I.M. (M=5.09°, SD=1.75) and C.G. F.M. (M=5.99°, SD=3.97) values, t(19)=0.92, p=0.37.

Table 2 – Results of the independent sample t-test for each of the measurements (I.M. and F.M.) between the experimental (E.G.) and control (C.G.) groups

	Group	N	Mean	S.D.	t	df	p	Mean Diff.
Striking Angle I.M.	E.G.	20	5.40°	1.70	0.56	38	0.58	0.31°
	C.G.	20	5.09°	1.75				
Striking Angle F.M.	E.G.	20	1.81°	1.02	-4.56	38	0.00	-4.18°
	C.G.	20	5.99°	3.97				

The independent samples t-test was used to compare the values of the angle of impact under the initial measurement conditions of the two groups. No statistically significant difference was found between the values of E.G. (M=5.40°, SD=1.70) and C.G. (M=5.09°, SD=1.75); t(38)=0.56, p=0.58. These results suggest that the two groups are homogeneous in terms of the values obtained at the time of the first measurement.

We performed the independent samples t-test to compare the values of the angle of impact in the final measurement conditions of the two groups. A statistically semi-significant difference was found between the

E.G. (M = 1.81°, SD = 1.02) and C.G. (M = 5.99°, SD = 3.97) values; $t(38)=-4.56$, $p = 0.00$. These results suggest that E.G. outperformed C.G., so the drills, technical complexes and bilateral play had the desired effect at the beginning of the research.

Discussions

The findings of this study reveal that targeted training interventions significantly influenced the striking angles in the experimental group, with a notable reduction in the striking angle F.M. (mean difference: -4.18°, $p < 0.05$) compared to the control group. This outcome suggests that the structured drills employed were effective in refining this technical element of the soccer inside foot strike. However, the striking angle I.M. showed no significant changes, likely due to the inherently smaller initial variation between groups.

These results align with findings from other research into soccer kicking biomechanics. For instance, Kellis and Katis (2007) emphasize the importance of joint coordination in achieving precision and power during side-foot kicking. Their study highlights that efficient neuromuscular control is pivotal for accurate execution, which resonates with the improvements observed in our experimental group following the intervention. Similarly, Tamura et al. (2023) noted that targeted training can improve joint stiffness and coordination, critical components for stabilizing the supporting leg during the kicking motion, further supporting the importance of focused practice in enhancing technical skills.

Another relevant study by Lees et al. (2009) examined the role of pelvic motion in the accuracy of soccer kicks, reporting that a stable pelvis during support foot contact is crucial for precise ball impact. Although our study primarily focused on the foot strike angle, the structured training likely contributed to a more controlled overall kicking posture, indirectly influencing accuracy and efficiency.

The practical implications of this research are clear: targeted exercises, such as those involving wall passes, bilateral drills, and small-sided games, can significantly refine technical skills, particularly the inside foot pass. Coaches and educators should incorporate these drills to improve not only physical execution but also players' confidence and teamwork. Furthermore, findings from studies like Tamura et al. (2023) and Nunome et al. (2002) stress the importance of biomechanical analysis in tailoring training programs to the specific needs of players, including those with chronic conditions like ankle instability.

The substantial improvement in the experimental group's performance underscores the critical role of structured training in developing foundational sports skills, particularly in soccer. This aligns with findings by Carlsson et al. (2019), who observed that a short, technique-intensive training period significantly enhanced side-foot kick performance among elite female soccer players. Their study emphasized the value of repeated, focused drills in refining technical execution, which parallels the positive effects of the training interventions applied in our study. Similarly, Ahsan (2018) highlights the importance of angular kinematics, particularly during the impact phase of the inside kick, in optimizing performance. This suggests that our structured drills may have contributed to better coordination and mechanics, thereby improving striking angles and execution.

Several limitations must be acknowledged, despite the promising outcomes. The generalization of these results are limited by the relatively small sample size and short intervention duration. Future studies should consider larger and more diverse populations, along with longitudinal designs, to evaluate the sustainability of these technical improvements. Additionally, integrating motion capture systems, as demonstrated by Nunome et al. (2006), could provide deeper insights into biomechanical adjustments during training and gameplay.

Expanding performance metrics to include other kinematic and kinetic variables, such as joint moments and foot swing velocity, could also yield a more comprehensive understanding of the effects of training interventions. Exploring these variables in different demographic groups, such as younger or less experienced players, would further validate and extend the applicability of these findings.

Conclusions

Based on the analysis of the collected data and the interpretation of the results, several key conclusions can be drawn that align with the initial objectives of this study. The findings indicate that the striking angle of the ball, when using the inside of the foot (with the instep), can be improved through the use and practice of wall-passing exercises, paired drills, technical complexes, and bilateral games with specific themes.

The use of a select number of well-chosen exercises, repeated multiple times, proves to be not only a current trend but also an effective method for developing technical skills in detail. Mastery of technical executions at higher speeds and in adversarial conditions enhances the fluidity of play through simple and efficient actions. The striking angle in

passing techniques, influenced by repeated exercises, technical complexes, and themed games, became more precise, alongside improvements in execution speed, ball speed, and player movement.

Additionally, the students' determination to succeed and improve their passing technique, particularly with the inside of the foot, was evident. The importance of altruism in football was also emphasized, with bilateral games playing a crucial role in fostering teamwork and cooperative play.

The results obtained from the experimental group confirm the hypothesis of the study: a noticeable modification in the striking angle of the inside foot pass was observed among students following the application of wall-passing exercises, paired drills, and thematic bilateral games.

Nevertheless, further research is needed to explore the long-term effects of these exercises, technical complexes, and bilateral games on a larger sample size. This would help establish a more comprehensive understanding of the impact of these interventions over time.

Methodological recommendations include ensuring that students in the educational process are provided with the necessary equipment and materials that meet at least the minimum requirements of the lesson objectives. Furthermore, monitoring the health and well-being of students is essential to prevent injury during training.

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