Research Lines in Coaching Science: A Perspective from Sports Performance Analysis

Líneas de Investigación en Coaching Science: Una Perspectiva desde el Análisis del Rendimiento Deportivo

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Abstract:

This paper presents a review of the research lines developed within the discipline of Coaching Science, specifically articulated under the approach of Performance Analysis in Sport. It describes the scientific production of the GOERD Research Group, focusing on the study of the training process and competition from an applied and multidisciplinary perspective. The article details seven main research topics: coach behaviour, referee analysis, the study of technique, critical incidents, performance indicators, tactical patterns, and technical effectiveness. Through observational methodologies, advanced statistical analysis, and the use of inertial technologies, sport is addressed as a complex and dynamic system. The results offer validated instruments and predictive models that contribute to performance optimization, the professionalization of coaches and referees, and the improvement of decision-making in team sports.

Keywords:

Coaching science, sports performance analysis, sports training, performance indicators, team sports.

Resumen:

Este trabajo presenta una revisión de las líneas de investigación desarrolladas en la disciplina de las Ciencias del Entrenamiento, articuladas específicamente bajo el enfoque del Análisis del Rendimiento Deportivo. Se describe la producción científica del Grupo de Investigación GOERD, centrada en el estudio del proceso de entrenamiento y la competición desde una perspectiva aplicada y multidisciplinar. El artículo detalla siete tópicos principales de investigación: el comportamiento del entrenador, el análisis de la labor arbitral, el estudio de la técnica, los incidentes críticos, los indicadores de rendimiento, los patrones tácticos y la eficacia técnica. A través de metodologías observacionales, análisis estadísticos avanzados y el uso de tecnologías inerciales, se aborda el deporte como un sistema complejo y dinámico. Los resultados ofrecen instrumentos validados y modelos predictivos que contribuyen a la optimización del rendimiento, la profesionalización de entrenadores y árbitros, y la mejora de la toma de decisiones en deportes colectivos.

Palabras claves:

Ciencias del entrenamiento, análisis del rendimiento deportivo, entrenamiento deportivo, indicadores de rendimiento, deportes de equipo.

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Introduction

Sport Sciences constitute a multidisciplinary field of knowledge in which biological, social, and pedagogical sciences converge. The International Council of Sport Science and Physical Education (ICSSPE) has recognized sixteen scientific disciplines within this field (Borms, 2008), delimiting their objects of study and research lines. Our research trajectory has been developed mainly within the disciplines of Coaching Science and Sport Pedagogy. In the present paper, we focus only on the former, which is oriented toward the scientific study of the training process and coach intervention from an applied perspective.

Within this discipline, our research has been conducted around the line of Performance Analysis in Sport, focused on the analysis of behaviour, load, and effectiveness in sport through observational, technological, and statistical methodologies. The development of the different research topics has taken place within the GOERD Research Group (*Grupo de Optimización del Entrenamiento y Rendimiento Deportivo*) at the University of Extremadura. The specific disciplines, research lines, and topics structuring our scientific production are presented below (Table 1).

Table 1.

Scientific disciplines, research lines, and topics in which I conduct research

Scientific discipline	Research line	Specific topics
COACHING SCIENCE	*Performance Analysis in Sport*	Analysis of Coach Behaviour
		Analysis of Referees and Officials
		Analysis of Technique
		Critical Incidents and Perturbations
		Performance Indicators for Different Sports
		Tactical Patterns of Play
		Technical Effectiveness
SPORT PEDAGOGY	*Teachers, Teaching and Coaching*	Identification and Development of Sports Talent
		Planning and Control of Sports Training
		Sports Education Models
	Teacher and Coach Education	Sport Coach Expertise
		Sports Coach Profiles
		Pedagogical Content Knowledge of Sports Coach
		Training and Update of the Sports Coach

Research Developed Within the Discipline of Coaching Science

Within the classification of scientific disciplines established by the ICSSPE, Coaching Science is recognized as one of the central areas of Sport Sciences (Borms, 2008). This discipline addresses the training process and coach intervention scientifically, integrating knowledge from physiology, psychology, pedagogy, and biomechanics to optimize athlete performance and development. Coaching Science conducts applied research on human behaviour, focusing on the planning, intervention, and evaluation of training and competition processes.

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Within this discipline, we have developed our research primarily in the line of Performance Analysis in Sport, aimed at recording, describing, and evaluating athletes' motor and tactical behaviour in real practice contexts (O'Donoghue, 2010). This line seeks to provide objective and reliable information that contributes to understanding the factors determining sporting success, facilitating coach decision-making, and improving teaching and training processes. It integrates technical, tactical, physical, and contextual analysis of performance and constitutes a particularly relevant area of applied research in team sports.

Throughout our research trajectory, we have led, coordinated, supervised, and participated in studies within several of the research topics that O'Donoghue proposes should be included within this line. Some examples of research conducted in these topics are presented below.

Analysis of Coach Behaviour

The Analysis of Coach Behaviour is one of the central areas within Performance Analysis in Sport, as it addresses how coaches' pedagogical, communicative, and organizational behaviours condition teaching-learning processes, training load, and performance development. This approach makes it possible to understand the dynamics of coach intervention through the systematic observation of decisions, communication styles, planning, and training control (O'Donoghue, 2009), integrating the behavioural component into the global analysis of sports performance.

In youth basketball, research has characterized coach intervention from two complementary perspectives: the pedagogical planning and structure of training, and the coach's decision-making and leadership styles.

Planning and pedagogical structure of training

The results obtained have described how coaches structure training tasks, identifying the key pedagogical training variables (Cañadas et al., 2015), as well as the pedagogical variables that define practice, game phase (Cañadas et al., 2012), game situation, type and content, and training means. These studies have made it possible to identify the pedagogical structure of training tasks by examining the relationship between pedagogical variables and game situations (Cañadas et al., 2009; Reina et al., 2018). For this purpose, the design and validation of the SIATE system (*Sistema Integral para el Análisis del Entrenamiento*) has been a crucial tool in our research (Ibáñez et al., 2016).

Coach decision-making, leadership, and planning styles

Recent work has broadened the analysis to include decision-making and leadership processes. The findings show the predominance of democratic and flexible styles among Special Olympics Portugal coaches, oriented toward adapting training to athletes with intellectual disabilities (Pires et al., 2022). Likewise, the results obtained have made it possible to identify leadership competencies in football coaches (Neto et al., 2023). These studies, framed within international collaborations, consolidate the study of coach behaviour in inclusive and professional contexts and include the validation of instruments on planning and decision-making styles (Feu, Ibáñez, & Gozalo, 2007; Feu, Ibáñez, Graça, et al., 2007).

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Empirical evidence has generated a solid body of knowledge on coaches' pedagogical behaviour and its influence on teaching and performance in team sports. The resulting methodological contributions, such as the development of the PyC Basket program and the application of the SIATE system, have made it possible to operationalize pedagogical training variables and generate replicable analytical models in different sporting contexts.

Analysis of Referees and Officials

The Analysis of Referees and Officials is a consolidated topic within Performance Analysis in Sport, aimed at understanding the physiological, kinematic, and psychological demands they face during competition (O'Donoghue, 2010). Unlike players, referees must maintain a balance between controlling the game and making real-time decisions, which requires optimal physical condition and high emotional and cognitive self-regulation.

In this area, a pioneering line of research was generated devoted to the multidimensional analysis of basketball refereeing, combining inertial technologies, observational methods, and psychological questionnaires. Our studies range from the design of observational instruments to the analysis of internal and external load, relating physiological, kinematic, and emotional variables to refereeing effectiveness.

Observational instruments and refereeing assessment

The design and validation of the IOVAB (*Observational Instrument for the Evaluation of Basketball Referees*), composed of six dimensions—uniformity, physical condition, mechanics, violations, fouls, collaboration, and game control (García-Santos & Ibáñez, 2016)—provided a methodological framework for the observational analysis of refereeing and for subsequent studies on stress, load, and performance. Based on the IOVAB, gender differences in the perception of competitive stress among referees have also been analyzed (García-Santos et al., 2017).

Internal load, external load, and accelerometric profile

Using UWB technology, internal and external load in international referees was quantified (García-Santos et al., 2019), as were the relationships between physiological and kinematic variables (García-Santos et al., 2022), and the variability of the load referees experience during competition (Ibáñez, Vaquera, et al., 2024).

The results obtained have contributed to the professionalization of the referee as an active agent within the sports performance process, positioning the GOERD Group as an international reference in the scientific analysis of officiating in team sports.

Analysis of Technique

The Analysis of Technique constitutes an essential pillar within this line of research, focusing on the biomechanical, motor, and contextual mechanisms that determine the efficient execution of sport skills. This topic seeks to identify the factors influencing the effectiveness, consistency,

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and adaptability of motor actions in real game situations (O'Donoghue, 2010). Technique, understood as a functional response to the tactical, physiological, and psychological demands of competition, must be analyzed from a contextualized perspective.

The research conducted has provided solid evidence in team sports and racket sports, combining multifactorial observational analysis, validation of technical instruments, and the application of effectiveness models in competitive contexts. These contributions are structured around three axes: multifactorial analysis of shooting in basketball, validation of observational instruments in padel, and the situational characterization of strokes in professional padel.

Multifactorial analysis of shooting technique in basketball

The studies conducted have highlighted technical differences between expert and novice players in shooting actions in professional and developmental competitions (Ibáñez, Feu, et al., 2008; Ibáñez et al., 2009b). These results reflect superior technical-tactical mastery associated with better perception and decision-making. In later studies, it was shown that free-throw effectiveness depends on competitive level, gender, and player role (Ibáñez et al., 2015).

Validation of technical analysis instruments in padel

Specific observational instruments have been developed and validated for the technical-tactical analysis of padel. The NAPOA (*Notational Analysis of Padel Observational Analysis*) makes it possible to record technical, tactical, and contextual variables of play with high validity (Escudero-Tena et al., 2022). Subsequently, the OASP (*Observational Analysis of Smash in Padel*) was designed to analyze the smash, including variables such as stroke type, direction, impact zone, and effectiveness (Escudero-Tena, Antúnez, et al., 2023). Both instruments constitute international methodological references in the study of technical actions in racket sports.

Technical and situational characterization in professional padel

This line of work has described execution and effectiveness patterns of the smash in elite players from the World Padel Tour, identifying differences according to handedness and on-court position (Escudero-Tena, Parraca, et al., 2023; López-Sierra et al., 2025).

These results demonstrate that technical effectiveness depends both on the quality of the action itself and on the situational context in which it is executed. The combination of systematic observation, statistical analysis, and validated instruments has made it possible to consolidate a rigorous methodology for technical study in team and racket sports. These contributions have promoted the shift from a descriptive approach to motor actions toward explanatory models of technical success, applicable to coach education and sports performance optimization.

Critical Incidents and Perturbations

The study of critical incidents and perturbations in team sports is grounded in the theory of dynamic and complex systems, where performance is conceived as an emergent, non-linear, and

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self-organized process, characterized by alternation between periods of stability and instability (Araújo et al., 2006). Within this framework, perturbations are events that temporarily alter the dynamics of the game, such as score changes, substitutions, or time-outs, and that provoke tactical and emotional reorganization within teams. These oscillations reflect the adaptive capacity of players and coaches in the face of competitive uncertainty.

From this perspective, the work has made it possible to describe the temporal dynamics of performance in professional basketball competitions, identifying the mechanisms that characterize critical moments of play and the transitions between states of stability and instability. To do so, advanced observational methods, time-series analysis, and mathematical transformations have been employed to model the dynamic interaction between teams as self-organized systems.

Game perturbations and contextual factors

In one of the earliest empirical approaches, we analyzed perturbations in ACB League matches using play-by-play records (Sampaio et al., 2010), identifying the period in which they most frequently occur, as well as the events with which they are associated. These findings showed that coach decisions function as regulatory mechanisms that restore the tactical stability of the system.

Complex systems theory applied to basketball

Based on the data obtained, empirical evidence has been provided regarding basketball as a complex adaptive system, in which time acts as a control parameter and offensive effectiveness as an order parameter (García-Rubio et al., 2013). In later studies, we extended this approach to the identification of critical performance moments in elite competitions, such as the Spanish Copa del Rey in basketball (Ibáñez et al., 2019).

In this research topic, the results provide evidence of sports performance as a dynamic and non-deterministic process, in which decisions, emotions, and contextual conditions are continuously interrelated. These contributions highlight tactical complexity in team sports and provide empirical foundations for the design of adaptive training aimed at managing competitive instability.

Performance Indicators for Different Sports

The study of Performance Indicators constitutes a central axis of Performance Analysis in Sport, as it provides quantitative and qualitative information explaining athletes' and teams' competitive success or failure (O'Donoghue, 2010). These indicators, both technical-tactical and physical-conditioning related, make it possible to evaluate competitive performance and serve as a reference for training planning and strategic decision-making. Their analysis must be adapted to the internal logic of each sport, taking into account its structural and situational characteristics.

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The results obtained have contributed to building a body of knowledge around two major families of indicators: technical-tactical indicators, focused on the analysis of game actions and their relationship with collective performance; and physical or load indicators, aimed at quantifying the physiological, kinematic, and neuromuscular demands of competition through inertial technologies and positioning systems.

Technical-tactical indicators

The research conducted has made it possible to identify the game indicators that predict performance during a basketball match (Ibáñez et al., 2003), considering athlete sex (Sampaio et al., 2004), analyzing game structure and performance differences according to playing position (Gómez-Carmona et al., 2026), starter or bench status (Gómez et al., 2009), competition phase, and situational context (Fernández-Cortés et al., 2021), throughout the competition (Ibáñez, Sampaio, et al., 2008), as well as in wheelchair basketball (Hernández-Beltrán et al., 2024). The study of performance indicators predicting victory while taking situational variables into account has been a constant in our research (Gómez-Ruano et al., 2008).

In the context of professional football, we demonstrated that load indicators help explain variations in physical demands according to competition phase, league ranking, and the impact of the pandemic context (Fernández-Cortes et al., 2023; Fernández-Cortes et al., 2024).

Physical and load indicators

Recent research has focused on quantifying internal and external load through inertial technologies. Particularly noteworthy is the analysis of different populations to describe internal load, kinematic, and neuromuscular profiles during competition. U14 (Rocha et al., 2025), U18 (Ibáñez, Gantois, et al., 2024), professional players (Ibáñez et al., 2023), and women players (Ibáñez et al., 2022) have been studied. These results make it possible to individualize load and define reference models in basketball. Likewise, it has been possible to compare training and competition loads in starters and bench players (Scanlan et al., 2025). This evidence highlights the need to monitor loads according to player role in order to balance preparation.

From an integrative perspective, the results provide a multidimensional understanding of sports performance, combining technical-tactical and physical-conditioning indicators applied to different sports, categories, and contexts. This line of work has made it possible to generate reference models, load profiles, and performance classifications that contribute to training optimization and to a comprehensive understanding of the demands of modern sport.

Tactical Patterns of Play

The analysis of Tactical Patterns of Play constitutes a key area within the research line of Performance Analysis in Sport, as it focuses on identifying the structural and functional regularities of collective behaviour that lead to sporting success. Tactical patterns are defined as recurrent configurations of interaction among players, delimited by situational variables such as location, score, or quality of opposition, which make it possible to model game organization (O'Donoghue, 2010). Their study represents one of the greatest challenges in Coaching Science, since

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it involves understanding how teams adapt their collective decisions to the changing conditions of competition.

The research conducted has contributed to consolidating a body of knowledge on tactical patterns in football and basketball, addressing three main dimensions: the influence of situational variables on tactical performance; game dynamics and the critical sequences that determine success; and the evolution of tactical patterns in response to rule changes or changes in competition format.

Situational variables and successful tactical patterns

The results obtained have identified the situational factors that modulate teams' tactical organization, both in the UEFA Champions League (García-Rubio et al., 2015), in professional women's football (Ibáñez et al., 2018), and in comparisons across different European leagues (Sánchez-Murillo et al., 2021).

Game dynamics and competitive contexts

In football, the findings show how venue and external conditions affect tactical behaviour. We observed that home teams display greater possession, effectiveness, and offensive aggressiveness, whereas the absence of spectators during the pandemic reduced the influence of the home advantage and altered game intensity (Fernández-Cortes et al., 2020; Fernández-Cortes et al., 2024). At the international level, we identified that the winning teams in the 2023 Women's World Cup displayed patterns based on ball control, progression through the central channel, and the creation of defensive breakdowns, in contrast to more direct styles from other confederations (López-Araya et al., 2025).

Evolution of tactical patterns and regulatory adaptation

In basketball, we demonstrated that rule modifications between 1995 and 2015 significantly altered the technical-tactical structure of the game (Ibáñez et al., 2018), as did differences according to continental championships (Ibáñez et al., 2018). These studies reveal how rule changes and competitions affect the game and reflect the adaptive capacity of coaches and players in response to new competitive conditions.

In short, this research has made it possible to identify successful tactical patterns applicable to different sports and competitive levels. The integrative approach, based on the analysis of situational variables, game dynamics, and regulatory evolution, has fostered a deep understanding of collective tactics. The combination of notational analysis, advanced statistical models, and situational contextualization has enabled the generation of useful reference frameworks for teaching, training, and tactical research in team sports.

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Technical Effectiveness

Technical Effectiveness constitutes an essential dimension of Performance Analysis in Sport, as it evaluates the extent to which the execution of a technical action successfully achieves the motor objective of the action, whether scoring, maintaining possession, or forcing an opponent's error. This effectiveness depends on the interaction between biomechanical, perceptual, tactical, and situational factors, and must therefore be analyzed from a multifactorial and contextualized perspective (O'Donoghue, 2010). Effectiveness indicators reflect the functional efficiency of the action within the dynamic game system, integrating both execution and outcome.

Our research has provided scientific evidence across different disciplines, such as basketball, padel, blind football, and goalball, through advanced observational methodologies and multivariate models that make it possible to identify the determining factors of technical effectiveness in real competitive contexts.

Shooting effectiveness in professional basketball

This analysis provides a multifactorial description of shooting in professional leagues (ACB and NBA) (Ibáñez, Feu, et al., 2008; Ibáñez et al., 2009a). These studies established the first predictive models of effectiveness according to contextual conditions, consolidating observational methodology in the technical analysis of basketball.

Technical effectiveness in adapted sports: blind football and goalball

The research conducted has made it possible to identify technical effectiveness in Paralympic sports, with particular attention to blind football and goalball. In blind football (FA5), we identified the relationship between successful teams and the variables defining shots on goal (Gamonales et al., 2019; Gamonales et al., 2018).

In goalball, the analyzed data reveal that low, laterally directed throws with low angular velocity are the most effective, especially when combined with an appropriate prior defensive sequence (Muñoz-Jiménez et al., 2021). These findings show that, in sports without visual information, technical effectiveness depends on auditory perception and spatial precision as the basis of motor control.

Effectiveness of strokes in professional padel

In padel, the research contributes to analyzing the effectiveness of decisive strokes—lobs, smashes, volleys, and *bandejas*—considering gender and competitive context (Escudero-Tena, Antúnez, et al., 2023; Escudero-Tena et al., 2020; Escudero-Tena et al., 2022). In the analysis of the Golden Point, we found that winning male and female players show greater technical effectiveness in decisive points, especially in smashes and early volleys (Escudero-Tena et al., 2023). The combination of technical precision, emotional control, and tactical reading explains performance differences in critical moments of play.

This research topic has generated a replicable methodological framework integrating systematic observation, multivariate analysis, and contextual interpretation of performance. The re-

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sults confirm that technical effectiveness depends not only on the motor action itself, but also on the situational context, defensive pressure, and the profile of the player. These contributions have supported the development of training models grounded in competitive reality, aimed at optimizing technical efficiency according to the demands of the execution environment.

Conclusion

The results of our research within the scientific discipline of Coaching Science and, more specifically, within the line of Performance Analysis in Sport, have contributed to a comprehensive understanding of the training process and competition from an applied scientific perspective. Through the study of coach behaviour, refereeing activity, technique and its effectiveness, performance indicators, tactical patterns, and critical game incidents, sports performance has been addressed as a complex, dynamic, and contextual phenomenon.

The contributions of the research developed within the GOERD Research Group, either through our own initiatives or through the supervision of doctoral and master's students, have enabled the development of validated observational instruments, predictive and explanatory models of technical and tactical effectiveness, and physical and contextual load profiles that have strengthened the link between research and training practice. This integrative approach, supported by observational methodologies, advanced statistical analyses, and the use of inertial-device technology, has fostered the professionalization of coach and referee intervention, as well as performance optimization across different disciplines and competitive levels.

Ultimately, our work positions performance analysis as a structuring axis of Coaching Science, aimed at improving decision-making, promoting evidence-based training, and contributing to the scientific and pedagogical development of contemporary sport.

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