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CENTERING THE BODY: LEVERAGING SELF-EFFICACY AND TECHNOLOGY FOR SPORT PERFORMANCE ENHANCEMENT

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Abstract: Sport performance is influenced by a complex interplay of multidisciplinary factors. Methodological strategies play a key role in shaping athletic performance. Physiological adaptations are interconnected with training methodologies, both as causes and consequences of morphological changes. On the other hand, cognitive and psychological are occasionally overlooked. Yet, they are pivotal in determining an athlete's achievements and should be consistently integrated into training regimens. Bandura's self-efficacy (SE) theory has garnered recent attention, emphasizing its impact on athletic performance and coaches should integrate it into training setting. Moreover, the strategic use of technological tools like sensors offers invaluable insights, aiding both players and coaches in obtaining critical data for optimizing performance. However, while these tools often adopt a quantitative approach, there is a need for more sophisticated methods encompassing qualitative assessments of movements and sports performances. Addressing this challenge demands swift data analysis for interpreting athlete SE, evaluating performance objectively, and providing timely responses. A proposed methodological approach involves an algorithm capable of real-time analysis, amalgamating data from technological tools and athlete SE information. This algorithm aims to offer prompt, comprehensive feedback to improve SE and consequently enhance athletic performance.

Keywords: Self-efficacy; Performance; Sport; Technology

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1. Sport performance

The definition of sport performance transcends mere technical proficiency; it encompasses a broader dimension beyond the mastery of skills. It extends into the realm of character and mentality, encapsulating not only the knowledge of how to execute physical tasks but also emphasizing the significance of mindset, attitude, and personal attributes. Hence, it is imperative to recognize that excelling in sports involves a holistic approach that integrates both the technical expertise and the psychological and physiological aspects, establishing the 'know how to be' as a fundamental component alongside the 'know how to do' (Agosti, 2021). The evolution of knowhow has shifted its focus towards emphasizing the paramount importance of the body, portraying it not merely as an instrument of action but as the core entity itself. This transformation highlights the essence of being, prioritizing the body's qualities, capacities, and condition before its actions those are then a consequence. In this paradigm, the body's state of being assumes precedence, shaping and influencing the subsequent actions it undertakes, thus affirming the notion that the body's 'being' precedes its 'doing' in the pursuit of peak performance. A comprehensive approach by a coach within the realm of sports undoubtedly enables a thorough understanding, elaboration, and formulation of plans, strategies, and approaches. This method prioritizes holistic development, not only focusing on enhancing individual performances and team dynamics, but also on nurturing individuals as both physical entities and cognitive beings. Such an approach considers the complete development of the body (Borgogni, 1993), addressing their physical prowess and mental fortitude to ensure a well-rounded and balanced growth within the sporting arena.

Within this paradigm, the body and, consequently, sport performance are subject to diverse influences that possess the capacity to either augment or diminish their efficacy (Silva et al., 2022). An array of factors exerts an impact, serving as potential enhancers or detractors, shaping the body's condition, and subsequently affecting the overall performance in sports.

The coach's objective extends beyond merely shaping the capabilities of athletes; it is to empower them to fully express themselves, drawing out the latent potential inherent within their bodies (Bertagna, 2000). The coach strives not to impose a predetermined mold onto the athletes but rather to facilitate an environment where athletes can unleash their innate abilities and talents. It is about guiding and nurturing, creating space for individual expression, enabling athletes to tap into their inherent strengths and capabilities, and ultimately realizing their fullest potential (Sibilio, 2005). Coaches should prioritize the methodology utilized in training programs throughout the season, recognizing its pivotal role in optimizing an athlete's performance. An example of such significance lies in the concept of periodization, crucial for refining an athlete's abilities while ensuring time is not squandered nor efforts rendered ineffectual (Weineck, 2019). While training methodologies ought to align with the intricacies of a specific sport, an athlete's position, and predetermined objectives, the primary consideration remains the adaptability of these approaches to suit the distinct needs and characteristics of each athlete. Customizing methodologies in line with individual requirements enhances the efficacy of training, underscoring the importance of tailoring approaches for maximum effectiveness.

Various methodologies exert distinct influences on the body, primarily resulting in morpho-functional adaptations (McArdle et al., 2010). This phenomenon accentuates the pivotal role the body assumes in both the alteration and enhancement of performance. The physiological transformations stemming from these adaptations are intricately linked to the body's morphological peculiarities, significantly impacting motor function and control. As the body undergoes these physiological changes, it

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not only shapes, but also dictates the efficacy of motor function and control, underscoring the profound interplay between methodologies, bodily adaptations, and consequent performance improvements.

Nevertheless, the individual is more than just physical abilities; they possess a cognitive dimension integral to their performance (Kalén et al., 2021; Trecroci et al., 2021). Unfortunately, coaches often underestimate the importance of cognitive aspects in training regimes. The performance is profoundly influenced by cognitive factors, even if the integration of these elements within the methodologies could be challenging. However, recognizing the impact of these mental aspects is crucial, suggesting the need for identification of methodologies that conscientiously consider and incorporate these particular aspects to optimize an athlete's overall performance. In recent years, the scientific focus within this domain has significantly centered on the concept of self-efficacy (Aizava et al., 2023; Baretta et al., 2017; Lybbert & Zheng, 2023; Mitić et al., 2021; Raman & Rajaraman, 2023; Reigal et al., 2019).

2. The role of Self-efficacy in sport environments (intra-body)

Self-efficacy is the "beliefs in one's capabilities to organize and execute the course of action required to produce given attainments" (Bandura, 1997). This definition highlights two pivotal terms: belief and capability. These terms underscore the intimate relationship between self-efficacy and actual performance. A discrepancy between these two can create, or sometimes result from, an illusion that initially impacts performance and subsequently its perception. However, without the requisite skills, any advantages gained from enhancing self-efficacy would prove futile. Albert Bandura's self-efficacy theory posits that an individual's perception of their own abilities directly influences their behavior and performance (Moritz et al., 2000). A person with high self-efficacy is more likely to actively engage and strive for success. This is particularly relevant in sport performance, where confidence in one's abilities can enhance concentration, motivation, and commitment. While self-efficacy is a significant factor, there are many other variables that influence motor performance. However, it is crucial for educators and coaches to recognize the importance of self-efficacy and work towards developing athletes' confidence in their own abilities.

Self-efficacy develops over time through various information that influences the perception of one's abilities (Feltz et al., 2008). Integrating methods into training programming that aim to enhance self-efficacy is crucial. However, for this approach to be truly effective, it is essential to consider various factors. It has been observed that the correlation between sports performance and self-efficacy peaks when a specific exercise is evaluated and self-evaluated (Moritz et al., 2000). Activities or gestures, seemingly simple but hiding a high complexity in their structure and execution, could be difficult to evaluate independently, making them unsuitable for training and improving self-efficacy. This does not imply the impossibility of applying self-efficacy to specific exercises or movements, but it highlights the importance of breaking down a complex gesture into different analytical stages. This allows for the acquisition of necessary skills not only in execution but also in self-evaluation. For instance, jumping is an indispensable tool in various sports and game phases. In individual sports, it is used not only in specific disciplines like high jump, long jump, or pole vaulting, but also in sports like tennis or some martial arts. In team games, jumping is an equally important gesture, sometimes characterizing, as in basketball or volleyball, but it can also be used occasionally, as in soccer for a header or in handball for a jump shot. The importance of self-evaluation of this peculiar gesture may be fundamental to enhance the performance in several sports.

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3. The role of technology in sport environments (extra-body)

The evaluation process within sports training, often conducted with the aid of technological tools, tends to be regarded as a sporadic phase, intervening occasionally to assess players' performance against implicit criteria. This approach, limited to merely judging individual athlete performance, neglects the advancements in teaching and training methodologies. Consequently, it perpetuates outdated training models rooted in individualistic coaching paradigms, emphasizing judgment based on player behavior rather than fostering progress in motor learning. A necessary shift in evaluation perspective is imperative, redirecting focus toward the overseeing formative processes. This approach views performance evaluation as a dynamic, ongoing process, continuously monitoring the effectiveness of the methodology. Reliability in evaluation is crucial during the planning phase of training programs, necessitating a shift from intuitive assessments to data-driven analyses through robust technological tools.

Functional assessment in sports involves the comprehensive analysis and quantification of an athlete's physiological characteristics, serving as a vital tool to comprehend their fitness status, areas necessitating improvement, and proximity to achieving set objectives. This process employs a series of technology tools and tests gauging physical fitness to ascertain, predict, or describe an athlete's physical and sports performance, aiming to optimize performance across various athletic levels.

The quantitative data yielded by these technological tests, though objective and easily comparable, necessitate meticulous analysis, accurate processing, and a deep understanding of their implications. Despite their measurable nature, there lies ambiguity in how truly representative these objective data are of the athlete being evaluated a consideration that heavily depends on various factors.

The evaluation that considers the body as a collection of independent modules risks overlooking their intricate interconnections. Recognizing these interdependencies is vital, guiding evaluations not as dissected parts but as an interconnected whole. This perspective identifies player-specific needs, highlighting areas crucial for improvement in both in the body and performance domains.

The technological tools employed in sport are different. They differ from the technology they use and from the aim of their evaluation. GPS, for instance, are used to track the movement in the field and to check the speed of the player or the time that the player spends running beyond a certain velocity (Windt et al., 2017). Load cells inertial sensors and accelerometers may be involved in the segmental or global evaluation of the force control (Cogliati, Cudicio, Martinez-Valdes, et al., 2020; Cogliati et al., 2024), of the movement velocity or the rate of torque development (Cogliati, Cudicio, Toscani, et al., 2020) and give information on the qualitative evaluation of the locomotion (Lewin et al., 2022).

Understanding how each facet influences others is pivotal for a comprehensive evaluation, facilitating holistic enhancements in sports performance.

4. Optimizing Performance

Thoroughly assessing athletes and aligning these evaluations with their cognitive aspects, especially concerning self-efficacy, presents a compelling challenge that demands a specific procedure. The process involves multiple sequential tasks. Firstly, adhering to Bandura's guidelines (Bandura, 2005), the initial step entails assessing self-efficacy using a well-designed questionnaire. Secondly, determining the degree and strength of self-efficacy is essential. Thirdly, utilizing a reliable technological tool, coaches test the athlete's performance. Subsequently, the obtained performance values undergo thorough analysis and interpretation. Following this, a comparison is

drawn between the self-efficacy level and the actual performance values achieved. Finally, the coach provides valuable feedback to the player, aiming to enhance both self-efficacy and performance levels. Furthermore, coaches need to meticulously choose a specific task when implementing this procedure, recognizing that combining various movements or tasks can significantly impact the reliability of self-efficacy assessments (Bandura et al., 1999; Moritz et al., 2000). To counteract this potential issue, coaches should deconstruct complex and overarching movements into separate, analytically distinct tasks. This approach ensures a more dependable self-efficacy assessment, mitigating potential biases stemming from other influencing factors.

This procedure, previously employed in other studies (Cudicio & Agosti, 2023, 2024), offers a reliable means to assess self-efficacy levels and compare them with actual performance. Certainly, the method employed in these studies facilitates a reliable comparison between the athlete's actual performance and the self-efficacy, encompassing even predicted and perceived performance levels. Additionally, this approach aids in identifying any discernible patterns of overestimation or underestimation, enabling athletes to discern discrepancies between their perceptions and actual performances. Nevertheless, despite its promise, this procedure demands a considerable amount of time, a luxury often unavailable to coaches during their training sessions.

Artificial intelligence stands as a promising solution for expediting the analysis and comparison between performance and self-efficacy. Utilizing an algorithm becomes imperative to swiftly compare the outcomes of diverse tests. Using as an example the procedure applied in a previous study (Cudicio & Agosti, 2024), the system would directly analyze the questionnaire results related to a squat jump's height. Subsequently, following the jump, the system would collect the actual performance data and compare it with the self-efficacy level, strength, and the estimated height of the jump. The feedback provided to the athlete holds the potential to enhance all three aspects mentioned, consequently elevating overall self-efficacy. This immediate feedback loop becomes a substantial reference point in gauging the reliability of an athlete's cognitive perception, thereby fostering improvements in self-efficacy levels and significantly enhancing overall performance (Feltz et al., 2008). Furthermore, artificial intelligence can integrate this data with information from various other technological devices, such as motion capture systems (Rucco et al., 2020; Vastola et al., 2016), providing comprehensive insights into the quality of movements. By assimilating data from different athlete tasks, artificial intelligence has the potential to learn from diverse experiences (Di Tore, 2023), enabling it to offer informed and reasoned feedback. This integrated approach not only enhances the depth of analysis but also allows for tailored feedback based on a broader spectrum of athlete performance, thus contributing to more nuanced and individualized coaching interventions.

Implementing this technological approach holds substantial promise in significantly enhancing and streamlining the coach's role. By interpreting the numerical results of evaluations as qualitative information, coaches can effectively leverage this data to bolster individual performance and optimize bodily efficiency.

5. Conclusions

This study illuminates three pivotal facets crucial in optimizing athlete performance and training efficacy. Firstly, it emphasizes the significance of employing robust technological tools for a thorough qualitative assessment of athletes' performances. These tools serve as instrumental aids in meticulously analyzing various aspects of athletes' capabilities, offering precise insights that aid in tailored training regimens and targeted improvements.

Secondly, the study accentuates the profound influence of cognitive factors, particularly the role of self-efficacy, in shaping and refining sports performance. Acknowledging the impact of an athlete's belief in their abilities is pivotal in understanding how mental fortitude significantly contributes to on-field achievements. Integrating self-efficacy assessments into training programs enables coaches to tailor strategies that boost an athlete's confidence, resilience, and overall mental preparedness, consequently enhancing their performance.

Thirdly, the integration of artificial intelligence into data processing from evaluations and self-efficacy questionnaires offers promising avenues for expediting feedback mechanisms. artificial intelligence's ability to swiftly analyze multifaceted data sets provides coaches with actionable insights in near real-time, enabling them to deliver prompt, targeted feedback to athletes. This technological advancement not only saves time, but also ensures that athletes receive valuable, data-driven guidance, empowering them to make informed adjustments and improvements swiftly.

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