

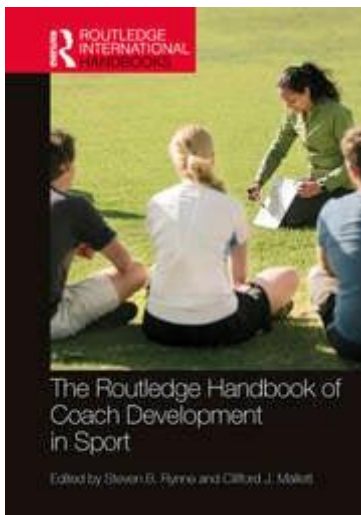
Working chapter

Citation of this chapter

Araújo, D., Sarmiento, H., Resende, R., & Gomes, A. R. (2024). Football coaching, the Portuguese way: The Ecology of practice as the referent for evidence-based coach education. In S. B. Rynne & C. J. Mallett (Eds.), *The Routledge handbook of coach development in sport* (pp. 271-284). Routledge. <https://doi.org/10.4324/9781003160939-21>

Versão original

<https://www.taylorfrancis.com/chapters/edit/10.4324/9781003160939-21/football-coaching-portuguese-way-duarte-ara%C3%BAjo-hugo-sarmiento-ruy-resende-ruy-gomes>



Chapter 18: Football Coaching, the Portuguese way: The ecology of practice as the referent for evidence-based coach education

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Abstract

In Portugal, coach education commenced a few decades ago. Coach education was not on the agenda during the Portuguese dictatorial regime (before April 1974) because the government did not formally recognize the importance of sport in Portuguese society. Indeed, physical education was implemented in 1940 only because it was useful as a means for fostering obedience and preparing young people for military service. However, since the spread of democracy, after 1974, and the influences of globalization, Portuguese society has become more conscious of the importance of sport for all populations. The formalization of coach education began during the 1980s and substantially increased in the subsequent years. The tipping point was when the government created the General Direction of Sports, which included an education department to support Portuguese sport federations in organizing courses and developing coach education (Resende et al., 2016). In this chapter, we start by discussing sport coach education in Portugal, including the grading system and the process for continuing education, and how the participation of the Universities, the Sport Federations and other organizations is regulated. We next discuss football coaches' education, where we describe in more detail the historical evolution that helps to understand the many world-level football coaches from Portugal. Then, we offer specific examples about how a scientifically sound *ecological dynamics* approach developed in Portugal supports coaches' education. At the end of the chapter, we sum up the key points of Portuguese coach education, with particular emphasis to football, as well as future directions.

Coach Education in Portugal

Like the rest of Europe, Portugal has experienced a significant move toward the professionalization of coaching (especially in football) over the past few years. Nowadays, several coaches work in paid positions. Still, given the social and community-based nature of coaching, the number of volunteer coaches is abundant and increasing.

Formal education for physical education teachers and instructors started in 1940 with the National Institute for Physical Education (*Instituto Nacional de Educação Física* – INEF, later *Instituto Superior de Educação Física* – ISEF – and presently *Faculdade de Motricidade Humana* – FMH), the first public school education focused on sport-related activities. Other public schools, offering physical education (PE) or sports education, would only appear in the 1980s.

There were several key people who influenced and shaped coach education in Portugal, especially in the 1980s. The first foray into sports science research was led by António Paula Brito and Francisco Sobral (first PhD at ISEF). Before them Mário Moniz Pereira and Teotónio Lima, during the late 1960's and 1970's, were key references in terms of organizing and delivering the curriculum for coach education. A key figure in coach education was the highly successful Moniz Pereira, who developed and coached several world-level Portuguese long-distance runners (Carlos Lopes, Fernando Mamede, Domingos Castro, etc.). There were also several domestic coaching journals that emerged in the 1980s (e.g., *Ludens*, *Horizonte*, *Agon*). In particular, we mention António Paula Brito's work in the 1960s as influential in Portuguese coach education. A key figure in organizing formal coach education, Brito was among the first to use observational tools in sport settings. These observational tools significantly impacted coach development in Portugal. These tools were used to systematically observe coaches in their natural environment, where coaching and playing occur. The impact of these observation tools was evidenced in the training methods later developed by the football coaches, Jesualdo Ferreira and Carlos Queiroz, who we will discuss later in this chapter.

Portuguese sport administrators identified the need to improve the quality of the coach education, and in 2008 established specific criteria for candidates to become certified Sport Coaches. Specifically in 2010 (IDP, 2010) it was established that the access and exercise of the sports coach activity was limited to the holders of the Sports Coach Credential (*Cédula de Treinador de Desporto* – CTD with grades from one to four. As coaches progress from levels one to four in the CTD, there is development of coaching competencies and capabilities. In 2012, the National Coach Education Program (*Programa Nacional de Formação de Treinadores* – PNFT) was formally created. The major change to the previous program (IPDJ, 2020a) was that sport coaching courses and coaches' education became the responsibility of a partnership among the Portuguese Institute of Sport and Youth (IPDJ), the Sports Federations with public utility status, and other organizations recognized by the IPDJ. Only these recognized organizations can provide certified education to coaches, including private enterprises, universities, and institutes.

Coach Grading System

Due the diversity of the sport system and the legal obligation to adhere to PNFT, a coaches' internship development was created. This coaching qualification was a graded system that builds upon the previous grade with cumulative knowledge and skills developed as you progress through each grade (see Table 18.1). This plan includes four

grades establishing profiles and skills for each qualification, with specific responsibilities and competencies for coaches. Each grade is defined mainly based on the population which coaches can work with (see Table 18.1).

Table 18.1

Coach activities and functions by grade, according to the PNFT (IPDJ, 2020b)

Coach Role	
Grade I	<p>Corresponds to the basis of the hierarchical qualification as professional sport coach, conferring competences for instructing sport initiation.</p> <p>a) Guide practitioners in the early stages of sports development.</p> <p>b) Develop competences to help coaches with grade II in their practice.</p>
Grade II	<p>Corresponds to the intermediate level in the hierarchical qualification as professional sport coach.</p> <p>a) Guide practitioners in the initial and intermediate stages of sports development.</p> <p>b) Develop skills to coordinate technical teams at levels of practice associated with grades I and II.</p> <p>c) Develop competences to help coaches with grade III in their practice.</p> <p>d) Assist higher-level coaches in planning, conducting, training and competitive participation evaluation.</p>

To be a coach in Portugal it is necessary to have a certificate, named Professional Title of Sports Coach (*Título Profissional de Treinador de Desporto – TPDT*), which is the purpose of the PNFT program. This certificate can be obtained in the following ways: (a) Sport coaching courses: coaching courses organized according to the legal and regulatory principles of the PNFT by recognized organizations; (b) Academic education: equivalent to a formal academic bachelor's degree in the Physical Education or Sport Sciences domain; (c) Recognition, validation, and certification of competencies; (d) Recognition of qualifications obtained abroad; and (e) Recognition of professional and academic skills. The PNFT also establishes the amount of practice (training) hours required for each coaching award should have (see Table 18.2). However, Federations may consider an increase in the number of hours depending on the training needs of coaches.

Table 18.2

Duration and components of coach education per grade (IPDJ, 2020b)

	Grade I	Grade II	Grade III	Grade IV	Total
General component	36h	60h	80h	32h	208h
Specific component	36h	60h	100h	220	416h
Internship	One season (minimum 6 months)	One season (minimum 6 months)	-	-	
Total	72h	120	180	252	624

Regarding the typology of practice, sport coaches' courses include three main curriculum/content areas: (a) General sport sciences education component; (b) Sport-specific component; and (c) Internship component. As stated by Resende et al. (2016):

The general component includes content based on scientific disciplines that support the coach work with fundamental knowledge to facilitate coaching while respecting fundamental human values. The sport specific component is based on specific knowledge required to coach a particular sport. The general education program and the regulation of the internship are IPDJ responsibility. The sport specific component is defined by the sports federations (p. 181).

The internship of coaches is a period where they link knowledge with competence in dealing with authentic coaching situations. This internship must be performed under supervision and with mentoring.

Key Components for Each Grade and Coach Knowledge

In 2020, the IPDJ (2020b) reformed the professional profiles of all coaching awards. Compared with the schedule proposed in 2010 (Resende et al., 2016), a substantial modification was made to the number of hours; specifically, decreasing the general component by 128 hours, including 5 hours less in grade I, 3 hours less in grade II, 11 hours in grade III, and 103 hours less in grade IV. These changes results from the evaluation of different experts from the national sports system arguing that the specific component would replace the general one by addressing these topics more specifically, according to each sport. The specific component increased its hours in the final grade: four hours less in grade I, the same in grade II, 10 hours more in grade III, and 85 hours more in grade IV. The internship is no longer required to complete grades III and IV. The specific component has greater prominence in more advanced grades as they correspond to the exercise of the activity at levels of high sports performance. The internship in those grades has been replaced with a reflexive activity. There is also a differentiation of the competencies of the initial stages of coaches training (grade I and grade II) in relation to the final stages (grade III and grade IV), being assumed as fundamental for the development of competencies related with *Pedagogy* and *Sports Methodology Training* in grades I and II. The assumption was that the initial stages of coach education correspond to the early stages of the athletes' sport development where basic training as well motor literacy assume a fundamental role (IPDJ, 2020b). However, there is a possibility that each sport federation might integrate the training units of the general

component into the specific training component. This option was followed by the football federation.

The University System in Sports Coach Education

Traditionally, before 2011, sport universities graduated students in Physical Education and Sport, preparing physical education teachers to complete a five-year degree. This teaching system also conferred the possibility of being a Grade I generalist sport coach. Such certification was under the responsibility of the sports federations that considered this formal education valid to become a qualified coach to young athletes. To obtain other degrees and awards and be able to work with older athletes, coaches should carry out courses held by the sport federations. There were certain exceptions where universities, in some cases, made available specific curricular units for some sports in their degree program, containing a greater number of hours of specific practice and training. However, the degree obtained never exceeded Grade II.

With the transition in the education system in response to the Bologna model in 2010 (Lima et al., 2012) there were substantial changes for the university system. The Bologna approach is a 3+2 model whereby the first three years equate to a Bachelor's degree and then after two further years of study, students graduate with a Master's degree.

The process of restructuring the coach education implied a general reduction in the number of hours, which was reflected in sports curricula. Simultaneously, universities also had to adapt their training programs to gather the new requirements of IPDJ. Thus, to certify the teaching in the university system, the courses were required to have a defined minimum number of hours related to the specific sport and had to include specific contents previously certified by the federations. In addition to these requirements, the teacher of the curricular unit needs to hold the grade of coach for that same sport.

As a result of these changes, Master's degrees have become diverse in their design and have become more specialized in the curriculum. For example, some programs were directed to teaching physical education in primary and secondary schools, others were directed to physical conditioning and health in fitness and health academies, and others were directed to sports training that educate sports coaches. This diversification allowed a deeper specialization in sports sciences with a focus on coaching the sport chosen by the student and future coach. These Master's degrees include in their second year a practical internship in which students are part of a technical team of a sport club seeking to combine the knowledge obtained in academic training with experience in the field. The internship includes a mentor in the sports club (with a grade/qualification higher than the student) and a university supervisor (with a grade/qualification higher than the student) who supervises the entire student education process. At the end of the process, the student should present and scientifically defend a report of the experience and work performed in the sport club.

Overall, these structural and subsequent curriculum changes have enabled a great evolution in the students' education. Also important, it standardized content to be taught at national level, requiring that universities have teachers with a sport coach degree and allowing a greater specialization of the education offered.

Continuing Professional Development

To keep the TPTD, coaches must continue with ongoing professional education and development, otherwise the coach certificate is suspended (Ministério da Educação, 2020). The IPDJ establishes the type of education required for ongoing certification and regulates the institutions that are eligible to deliver these *actions* with the credit units that correspond with training hours, the minimum number of credit units, and the procedures for accepting continuing education practices.

Each credit unit corresponds to five hours of face-to-face education and to ten hours of distance education (e-Learning). These CPD can be delivered in the form of courses, seminars, scientific conferences, among others, and focused on skills and competences specific to the sports context. To preserve the TPTD, three credit units are required for revalidation in all grades obtained during a three-year period. This obligation has the consequence of an exponential increase in proposals for coach education in different topics (general and specific), constituting a new dynamism in Portuguese coach education.

Football Coach Education

Association football or soccer (we use the term football in this Chapter) is the most popular sport in Portugal. According to Pordata (2020), football includes 190,865 athletes, 8623 coaches representing 1921 clubs. This dominance of football practitioners, compared with the other sports started about 40 years ago. The post-revolution period, after 1974, was very influential for football coaching education in Portugal.

The Roots of Football Coaches' Education

Coach education became a mission of higher education institutions, especially the Higher Institute of Physical Education (ISEF). This Institute (which changed to Faculty of Human Kinetics – FMH, in 1989) was a conceptual and social ‘upgrade’ from the National Institute of Physical Education (INEF), created in 1940, recognizing that the education of Physical Education teachers belonged to the university. Thus, in 1975, it integrated several institutions to create the Technical University of Lisbon (now University of Lisbon).

The systematization of football coach education began with the implementation of the Football Office at ISEF, led by Mirandela da Costa with the currently world-renowned football coach Jesualdo Ferreira. Some of the students of ISEF at that time, were Carlos Queiroz and Nelo Vingada, and a few years later José Mourinho and José Peseiro, who among others, became world-renowned coaches. The Football Office at ISEF was a place for teaching, practicing, and researching football. The knowledge that was produced was then disseminated to the Portuguese football coaches through a coaching magazine, published by the Portuguese Football Federation. Importantly, the knowledge and innovations that were developed went beyond technical, tactical, or physiological issues, but also discussed coaching pedagogy and ethics. Additionally, ISEF was instrumental in the development of football coach education courses, benefiting from the knowledge produced at the Football Office, the experiential knowledge from practitioners, and from the fact that Mirandela da Costa had become the general director of the General Board of Sport (DGD), the national institution to regulate and promote sport. These circumstances significantly facilitated the development and delivery of football coach education courses. Additionally, the Portuguese Football Federation recognized ISEF as the organization with the academic knowledge capability needed to support quality coach education. This

knowledge was different and innovative compared to the educational processes of the team sport games at the time, which were mainly based on experiential knowledge from practitioners.

Beyond football, ISEF benefited from the knowledge accumulated by a group of head coaches from the national teams of various sports, who simultaneously assumed teaching functions at the institution. As a result, an integrated training methodology was developed that sought to resist to the trend at the time to emphasize analytical training, and particularly the physical component of training. The perspective of INEF, and particularly the Football Office, was to integrate the contributions of different knowledge domains to develop a training methodology that integrated physical preparation with the tactical and technical preparation, as well as knowledge from the fields of sport psychology, sport pedagogy, observation, and movement analyses, among other areas. A significant output and milestone in this process was an academic book, written by the football coach Carlos Queiroz, who was already teaching at ISEF at the time (Queiroz, 1986). The book, which was also equivalent to a Master's thesis, was about the organization and structure of the training exercises in football. The knowledge presented in this book would become central to the evolution of the educational process in football. Now commonly used concepts and notions such as “complexity,” “specificity,” “game model,” “game phases”, and “game moments” helped to build a common language among football coaches.

The educational methods evolved quickly to design contexts that could recreate the constraints of the game, thereby providing guided discovery task approach for the development of players. Additionally, the educational methods were supported by science through the collection and use of psychological, physiological, and biomechanical data, among other types of data. One aspect that evolved very quickly was observation and game analysis, as well as the training sessions. During the 1980s, Queiroz and his staff sought to use methods to collect video images to analyse the evolutionary trends of the game and prepare footballers for the demands of football from a futuristic ten-year perspective (see Sarmiento & Araújo, 2021, for a detailed description and analysis).

The Impact of Carlos Queiroz on Coach Education and Development

Another salient and innovative aspect of Portuguese coach education and development that gained relevance throughout the 1980s was the identification and selection of players. Noting the organizational instability of sport clubs in Portugal, Carlos Queiroz instigated the Portuguese district football associations to select their best under-15 team. He then promoted the organization of a national ‘mega-tournament’ in Lisbon, which lasted for four days. During the tournament, he watched all the talented young players of the country, selected the best 35-40 players, and trained them regularly, using the methodology mentioned before, which he called “the developmental process”. This group of young players becomes the national youth team and trained together regularly for the year. At the time, Carlos Queiroz was the national youth coach, and he argued that these players must regularly play together in contexts of high-quality training, something that was not feasible in the players’ hometown clubs. The search for quality was a key goal of Carlos Queiroz, who proposed changing the competitive structure of young players, so that matches become more frequent.

Based on these events during the 1980s, there was a concomitant demand for better coaches and subsequently improved coach education. Hence, a robust knowledge base began to be built. This knowledge, in turn, was shared with those who enrolled in coach

education courses. Carlos Queiroz, who maintained both positions as a teacher at ISEF and national youth coach at the Portuguese Football Federation, developed a common language for the coaches, structuring the rationale and training organization based on a model, which included concepts such as game play, game principles, game phases, and game systems. Simultaneously, critical steps were taken concerning: (1) match observation and analysis, especially in major competitions; (2) the understanding of the game's evolutionary trends; and (3) the improvement of training methods.

The 1980s and 1990s were a pivotal, creative, and generative period in the development of coach education in Portugal, particularly the innovation of the training methodologies at the time. The legacy of the work of Carlos Queiroz on talent identification and development, the methodological shifts from previously established training methods, and systematic match observation and analysis distinctly marked the development of Portuguese football in general, and coach education in particular.

The consequences of this approach to coach education and to players' development culminated in two U-20 World Championship victories in Riyadh (1989) and Lisbon (1991), both under the leadership of Carlos Queiroz. The work implemented over a decade with a group of players who had been specifically selected for long-term development was rewarded with these international achievements. Before these World Championships Portuguese football players were known for being technically skilled but lacking competitiveness. After the work implemented by Queiroz, the dynamics of coach training evolved into a well-organized system with a curricular structure that encompassed several scientific domains. This system favoured the effective training of many coaches at different levels who began to implement new methodologies into their training regimens, which drastically improved the quality of Portuguese players' performance.

Education in Sport Sciences as a Key Influence in Coach Education

Carlos Queiroz left the Portuguese Football Federation in 1994. By that time, Portuguese players from his previous teams, who became professional players, were among the best in the world, such as Luís Figo, Rui Costa, Fernando Couto, Paulo Sousa, and Vítor Baía.

There was a proliferation of higher education institutions in Portugal during the 1990s that educated a wide range of professionals in sports science and coaching, many of whom specialized in football. These coaches, qualified in academia, received robust education in various scientific domains, over five years of undergraduate education. These well-educated graduates contributed valuable work in football clubs across the country, enhancing the skills of young footballers, and better structuring the coaching work in clubs. These improvements were reflected in a better and larger identification and the players' development. Additionally, training centres began to appear in the main Portuguese football clubs. These centres attracted better coaches promoting better professional practices. The return of Carlos Queiroz, in 2008, led to the reorganization of the Portuguese Football Federation's youth football system, as well as the organization of the coach education courses.

The beginning of the Millennium also coincided with the increased success of coaches who emerged in high-performance football through formal academic education. In a career, which was mainly conducted by ex-professional football players, a new wave of

coaches who studied in higher education schools began to succeed. Some of these also include Rui Vitória, Leonardo Jardim, Pedro Caixinha, Abel Silva, among many others.

Football Coach Grading System

Beyond the academic sport system with its own organization, the association football system is represented by the Portuguese Football Federation and locally by the District Football Associations. These associations organize and regulate the clubs' competitions. As mentioned before, the regime for becoming a credited sport coach was established in 2012, the so-called PNTF (*Programa Nacional de Formação de Treinadores*). In relation to football, this program needed to accommodate UEFA (Union of European Football Associations) demands. This was because UEFA has developed a parallel program for certifying coaches. The UEFA qualification is required for coaches to be formally recognized as such, in different European countries. Thus, it can happen that a coach who is qualified to coach in Portugal, is not recognized by UEFA as having a license to coach in another European country. This process of certifying coaches with UEFA's requirements, based on the education they have, is managed by the Portuguese Football Federation. Additionally, obtaining the highest level of coaching qualification (Grade IV, also named UEFA Pro), allows a coach to lead teams at the highest competitive level, takes a long time. The total education process from grade I to grade IV takes at least ten years.

In 2019, the national coach education plan was redeveloped. The Portuguese Football Federation reduced the general component, moving some of its contents to the specific component. This decision reduced the impact of academia in the football coaches' education. Nowadays, for the coach grading system, the Football Portuguese Federation established seven hours of training for the general component for Grade I, and 100 hours for the specific component, as can be seen in Table 18.3. The workload and the content addressed in the specific component in Grades I, II, III and IV are described in Table 18.3.

Table 18.3

Training units and specific components duration for grade I in Football (FPF, 2015a, 2015b, 2015c).

Training Units	Grade	Grade	Grade	Grade	Total
	I	II	III	IV	
Football Training Methodology	15	30	67	76	188
Football Technical/Tactical	30	30	40	44	144
Football Motor Skills	22	30	50	66	168
Psychology Applied to Football	15	17	18	24	74
Referee and Football Game Laws	12	12	10	6	40
Football Management and Organization	6	6	7	10	29
Communication and Image	-	-	-	24	24
Total Hours	100	125	192	250	667

The analysis of the specific components of Grades I and II (Table 18.3) reveals that some subjects (e.g., training methodology, psychology) were inserted with a unique focus in football. As a result, foundational contents of sport coaching (e.g., sports psychology, sports pedagogy, physiology) are not being taught. This approach implies an education focused on football, without the trainees' acquiring knowledge of the principles, methodologies, or techniques associated with movement literacy and sports practice in general. Moreover, general contents related to sports pedagogy and didactics have been removed, even though they are relevant for sport coaches developing young athletes. Anyway, Portuguese players and coaches continue to succeed. Their success may be due to the popularity of football in Portugal, where the practice of street football is still possible. Portuguese coaches cultivate knowledge about the game, about the specifics of football and players, and are open to international trends. Key institutions in Portugal, such as FMH-UL, FCDEF-UC and FADE-UP, continue to offer high-level education to sport coaches, with particular focus on football. These aspects may contribute to Portuguese coaches' creativity and innovation in aspects related to match observation and analysis, using scientific knowledge for making decisions, as well as the coaching process itself.

Ecological Dynamics as a Key Theoretical Approach to Portuguese Coaches' Education

As we previously described, Carlos Queiroz's approach conceptualized the football game as complex and dynamic. As such, it required a new approach to training, in which all exercises had to integrate the aspects of competition, from the physiological to the social. The game should be taught by playing it, Queiroz argued, retaining the complexity of the sport. He called that principle 'simplification of the complex structure of the game' (Queiroz, 1986). However, such simplification needs a theoretical guidance if it is to become part of coach education. This key aspect of the theoretical framework later developed as *ecological dynamics* (Araújo et al., 2006; Davids et al., 2005), which is a specific example about how football coaches are nowadays developed in Portugal. As mentioned before, in 1985, Queiroz was invited by the Portuguese Football Federation to lead the national youth team, where he was able to put his ideas into practice. "If I had any doubts when I started training the youth team on the basis of my methods, I lost them all," Queiroz said in 2017 to the Portuguese weekly newspaper *Expresso*, and "The progression of the players was exponential and the results spectacular in a short period of time." The impact of Queiroz's methodology extended beyond the pitch. As a lecturer, he taught a generation of coaches and influenced the design of training centres, where sports science students, while pursuing research projects, also learned on the job by coaching actual teams.

In sport pedagogy, an important challenge is to elucidate theoretical concepts underpinned by substantiated principles to design effective practice tasks and learning activities, undertaken daily, weekly, and monthly, in preparation for the physical, psychological, and emotional demands of competitive performance (Chow et al. 2020). This is not a trivial endeavour. However, in Portugal there was a happy coincidence. During the time Queiroz was implementing his methodologies, which highlighted the role of ecology in sport learning, Antonio Paula Brito was finalizing his PhD (in 1983) testing the observational methods he created in the 1960s under the scope of ecological psychology. Given the influence of Paula Brito in the Portuguese Sport Sciences Higher Education Schools as well as his ongoing participation in coaches' education courses, theoretical ideas began to match the practices and methodologies, something that was not

so evident with other laboratory-based theories. Founded on an ecological dynamics rationale and harnessing a constraints-based methodology for coaching (Araújo et al., 2004) it was proposed as an overarching pedagogical framework for sport coaching (for development of ideas in Nonlinear Pedagogy see Chow 2007; Chow et al. 2011). Based on the original insights of the ecological psychologist James Gibson (1979) an immutable principle to consider is the performer-environment system at the heart of practice micro-structure.

The *micro-structure* of practice (Davids et al., 2016) refers to the pedagogical activities that include the tasks designed, the constraints manipulated, the intentions harnessed, the emotions experienced, and the adaptations required of athletes during learning. The micro-structure of practice is designed to simulate critical aspects of competitive performance environments for athletes. A key challenge for sport coaches is to facilitate transfer of actions, perceptions and cognitions of athletes, or correspondence from behaviours in one context to behaviours in another context (Araújo & Davids, 2015), from training practices to performance environments, to enhance their attainment during competition. Relatedly, practice micro-structure needs to enable learners to act to seek and pick up high-quality information for decision-making and movement organization. A key role of sport coaches is to design practice micro-structure to facilitate players' attunement to critical information sources that can be used to regulate their actions during performance. Successful practice task design sport pedagogy helps learners to perceive and realize affordances (opportunities for actions) from a rich sport task design, matched to their specific capacities, skills, and experience (Davids et al., 2012; Araújo et al., 2019).

The theoretical framework of ecological dynamics conceptualizes athletes and sports teams as *complex adaptive systems* (for evolution of this idea, see Araújo & Davids, 2016; Araújo et al., 2020; Davids, Handford & Williams, 1994). These are highly integrated systems that are continuously changing over different timescales under interacting personal, task, and environmental constraints (Newell, 1986). Complex adaptive systems are inherently nonlinear, due to the potential for continuous interactions between system components. A challenge is to regulate system adaptations to achieve task goals and adapt to dynamic performance environments (Davids et al., 2016). Athletes learn how to satisfy unique task constraints from each competition through co-adapting their skills to affordances (opportunities for action) of such competitive performance environment (Button et al., 2020). Consequently, key pedagogical principles include the following (Chow et al., 2020):

1. Information regulates action and actions regulate information detection (information-action coupling);
2. Affordances need to be provided as invitations for action that athletes explore, discover, and learn to utilize;
3. Representative practice environments need to simulate tasks that offer specifying information of a competitive performance environment;
4. Effective constraints manipulations by sport coaches can channel athletes to co-adapt their behaviours to affordances of sport tasks in performance settings;
5. Inclusion of functional (non-random) variability in practice can enhance the adaptability of performers.

These key pedagogical principles can channel practice, especially through use of informational constraints to create learning contexts in which adaptive performance behaviours can emerge. More faithful simulations of a competitive environment during

practice are predicated on the quality of information designed into practice tasks, leading to more specific transfer from training to competition (Araújo & Davids, 2015). For example, in football, small-sided and conditioned games (SSCGs), with active defenders present, provide a more representative context in team sports for practicing attacking actions than without the defenders. Practicing shooting in the absence of a defender (outside game conditions in team sports like football or basketball), dribbling around cones or running in straight lines, are all activities with reduced levels of match information needed to regulate functional behaviours (i.e., the adequateness of shooting in this example) in competition. Specificity of transfer is more prominent in the former practice task designs (SSCGs), compared to the latter (static task constraints in drills), for the training of attacking actions. We highlight the role of constraints manipulation in the transfer of training, proposing how affordances in the micro-structure of sport practice can enhance athlete adaptability. It is well documented that effective constraints manipulation by sport pedagogists supports more functional coupling between information and action for the regulation of performance behaviours (Button et al., 2020).

The Design of Representative Learning Tasks by Coaches

Goal-directed behaviour is emergent, relative to the dynamics of competitive performance environments, since relevant performance solutions may vary: (i) within individuals during their athletic development (e.g., through growth and maturation in young athletes); and (ii), over the macro-timescale of years and decades as sports evolve, constrained by changes in tactical trends, equipment and technology, surfaces, rules, and regulations. Numerous examples exist of adaptations required within and between generations of athletes, such as changes to formats of sports such as football properties at major tournaments, or equipment technology and design.

Functionality in performance is predicated on the adaptive flexibility of athletes. That is why practice task constraints should be designed to encourage exploration of relevant performance solutions needed in competitive environments. Exploratory activity is an integral part of human development (Gibson, 1988). Continuous exploratory interactions with the environment, termed “experiments on the world” by E. Gibson (1988, p. 7) are typical in human development and lead to skills that can be harnessed in later athletic development when people start to specialize in competitive sport.

The implication is that practice tasks should be designed to help athletes become more skilled in seeking and discovering performance solutions that help them achieve their task goals. To achieve this aim, practice micro-structure should continuously seek to present each learner with a wide range of tasks and conditions that they need to explore. This type of design would enhance the skill of an athlete by helping him/her to become more adaptive, innovative, and flexible to cope with variations in task and environmental constraints (Araújo et al., 2004; Davids et al., 2016). Therefore, the micro-structure of practice should abound with problem-solving scenarios.

In ecological dynamics, the development of athletes over extended timescales is, in part, the result of their responsiveness to the design, types and modes of activities experienced, both structured and unstructured, during practice and play (Araújo et al., 2004; Davids et al., 2016; Coutinho et al., 2016). Güllich and colleagues have shown that early specialization in sport can lead to the emergence of success in athletes at the *junior* level (e.g., Güllich et al., 2017, Davids et al., 2016). However, they also showed that early diversification avoids the problems of early specialization and is associated with success

at *senior* level (see also data from Coutinho et al., 2016). Early variable, multisport practice is associated with gradual initial sport-specific progress but greater sustainability of long-term development of expertise. Conversely, early single-sport specialization with reinforced specialized practice is associated with rapid initial progress but compromises the sustainability of long-term development (Güllich, et al., 2021). This may be explained by the fact that children participating in multiple sports are associated with a lower risk of later overuse injury and burnout (Bell et al., 2018). Moreover, the focus on one main sport emerges from an athlete's experiences in multiple sports, which increases the odds that an athlete will select a sport at which he or she is particularly skilled. Finally, more varied earlier learning experiences facilitate later long-term domain-specific skill learning. This adaptive skill development happens because, variability in learning tasks may facilitate athletes' ability to adapt and regulate in learning (Davids et al., 2012).

In the micro-structure of practice continuum, the affordances available for utilization can range from being quite narrow and limited at one end (constrained by prescription and instructional constraints of a coach or teacher). They can also be extensively varied as captured in unstructured practice environments or when tasks are designed to facilitate exploratory behaviours and discovery learning (Chow et al., 2020). Coaches can move up and down this affordance continuum, designing practice micro-structure accordingly, depending on the needs of each athlete at any one time. The default approach in sport pedagogy does not have to involve spending inordinate amounts of time in low-intensity practice contexts, *simply rehearsing repetitive movements*, within a narrow field of affordances. Rather, athlete skill can be enhanced through *discovery* and *exploitation* of functional action solutions in a varied field of affordances to improve an individual's performance effectiveness. That is, typically a coach can work with performance analysts and an athlete in a sport to design dedicated practice environments, replete with specific affordances that are perceived and utilized, depending on the needs of an individual athlete and the team.

Summary and Future Directions

We highlight some key points about the coach education in Portugal should be highlighted:

- The education of coaches includes four grades that establishes knowledge, competences, and skills that should be acquired by coaches before starting the corresponding professional activity.
- The role of higher education institutions, federation associations, and other organizational institutions complement each other in the education provided to the coaches.
- The typology of coaches' education includes three main areas: general sport science component, sport specific component, and internship training component.
- The existence of the Sports Coach Credential is a valuable instrument to certify the quality of education and training provided to coaches.
- The Sports Coach Credential can be obtained through different ways, depending on each coach previous experience and professional profile.
- The Sports Coach Credential is maintained if coaches obtain continuing professional education and training.

In terms of football coaches' education, Portugal has been developing world-level coaches, who are working across the globe. Carlos Queiroz, Jesualdo Ferreira, and Nelo Vingada initiated the paradigm shift that has subsequently shaped this successful

approach to coach education and development. The genesis for this paradigm shift emerged in the 1980s when they combined new ideas for coaches' education (e.g., training centres), presented successful and impactful outcomes from their work as coaches, and instigated the need to be informed by sport science, in their work at the Football Office at ISEF (University of Lisbon). After this 'game changing' start, coaches' education was regulated by the Portuguese Sport Institute (IPDJ), that, in turn, led the creation of the National Coach Education Program (PNTF) in 2012, where sport coaching courses and coaches' education were a responsibility shared among IPDJ, the Sports Federations with sports utility status, and other organizations such as universities recognized by the IPDJ. However, in football, UEFA had also its own demands for its certification if coaches want to be professional (paid) coaches in a European country different from that where they obtained their formal education. The Portuguese Football Federation accommodated these constraints and presented its own education program and how it is compatible (or not) with that presented by Portuguese Universities and other institutions.

Regarding implications for coach education, it is important to achieve a better understanding of how education and training programs contribute to coaches' efficacy in different contexts of practice. Indeed, some major changes in educational programs are made without enough scientific evidence, making less clear the strategic options followed in coaches' education. For example, it is important to clarify the impact produced by the educational programs on the planning and action of coaches, because coaches can lead athletes in a wide range of ages (from young to adult players) as well as with very distinct needs and goals. This raises important questions, including:

Do the actual programs prepare future and actual coaches to understand the implications of coaching different individuals, as it is the case of children beginning the sport activity, teenagers interested in challenging their limits, performance athletes interested in maximizing sport success? Also, what goals are set by coaches in their daily work with athletes and how these goals influence their actions in training and competition settings?

For example, there is evidence that coaches' philosophy is an important aspect of coaches' activity and success (Gomes, 2020; Gould et al., 2017), but there is still a need to clarify what specific strategies and criteria are used by coaches to pursue their ideas (Cushion & Partington, 2016; Gomes et al., 2018; Jacobs et al., 2014). In summary, a double interface connecting education and practice needs to continue its improvement for coach education by accessing inputs about the best practices of educating coaches (as ecological dynamics and its pedagogical consequences may exemplify) and engaging with input from successful coaches about how they develop and lead athletes. This "double interface coach education process" can contribute to the positive impact produced by the educational programs on actual and future coaches.

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