THE ZONE OF PROXIMAL DEVELOPMENT (ZPD) AND THE SUPERCOMPENSATION: POSSIBLE RELATIONSHIPS AND IMPLICATIONS IN EDUCATION AND SPORT

LA ZONA DI SVILUPPO PROSSIMALE (ZPD) E LA SUPERCOMPENSAZIONE: POSSIBILI RELAZIONI E IMPLICAZIONI NELL'EDUCAZIONE E NELLO SPORT

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ABSTRACT
This article explores the connections between Vygotsky's Zone of Proximal Development (ZPD) and the theory of supercompensation in sports, hypothesising that their shared mechanisms could offer new perspectives for inclusive interventions. The findings highlight that structured stimuli and expert support foster superior cognitive and physical adaptations, emphasising the pedagogical value of a transdisciplinary approach to designing empowering educational and sports interventions.

Questo articolo esplora le connessioni tra la Zona di Sviluppo Prossimale (ZPD) di Vygotskij e la teoria della supercompensazione nello sport, ipotizzando che i loro meccanismi condivisi possano offrire nuove prospettive per interventi inclusivi. I risultati evidenziano che stimoli strutturati e supporto esperto promuovono adattamenti cognitivi e fisici superiori, sottolineando il valore pedagogico di un approccio transdisciplinare per progettare interventi educativi e sportivi potenzianti.

KEYWORDS
Inclusive Education; transdisciplinary approach; scaffolding; adaptive learning
Educazione inclusiva; approccio transdisciplinare; scaffolding; apprendimento adattivo

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Introduction

The aim of this article is to explore the similarities and possible relationships between the elements characterising the construct of 'supercompensation' and that of 'zone of proximal development', in order to try and reflect on the possible theoretical and applicative implications in the educational and didactic field, with particular reference to inclusive processes.

Although we are aware of the epistemological complexity (which cannot be adequately handled here) and of the risks of simplification and reductionism associated with such an objective, we believe that it may nonetheless be useful and interesting to open up a space for reflection on a possible inter- and trans-disciplinary field of theoretical and applicative research.

The main motivation in support of this work is based on the highlighting, by professionals who perform the 'dual role' of teachers and coaches, of similarities and analogies between the conceptual and operational dimensions of the two constructs, with particular reference to the phases and procedures for their realisation in sports and school activities. Both are relevant to the educational sphere insofar as they are closely connected to the processes of development, learning and empowerment and focus on the relationship between a learning subject and an expert subject who facilitates the development, learning and empowerment of functions and behaviors. More specifically, reflection on these aspects can foster professionals' awareness of the effectiveness of choices and practices that support authentic (effective and transformative) learning and participation, from an inclusive capacitating perspective.

Below are some considerations in this direction, starting from the definition of the two concepts and the identification in current and future scenarios.

1. Supercompensation and zone of proximal development: definitions and characteristics

The phenomenon of supercompensation was first described by Folbrot in 1941 and was later discussed in the 1950s by the Canadian endocrinologist Hans Selye, who defined it as the general adaptation syndrome (SGA), i.e. 'a physiological response to any demand (demand) from the environment, which always has three phases: alarm reaction, resistance to adaptation, and exhaustion or recovery'.

This means that there is a relationship between external stimuli (physical, chemical, social, psychological) and the organism's internal reactions. Specifically in the field of sport, supercompensation is the physiological response of any organism when

subjected to a certain training stimulus (called stress)[1] that breaks the body's condition of equilibrium called homeostasis[2]. The set of training stimuli forms the physical load[3], which is the cause of the body's adaptive response. Any condition that disrupts this balance is immediately compensated for by an equal and opposite reaction, aimed at bringing the system back into balance and improving the original performance level. The energy reserves, cellular processes and the various anatomical structures under stress do not return to their initial state, but rather exceed it, placing themselves at a slightly higher value. This process was studied at length by Russian physician Nikolai N. Yakovlev, who made the Leningrad Research Institute famous during the Cold War for his discovery of the specific link between biochemistry and exercise, i.e. the biochemical response of a tissue depends on the training performed. Supercompensation is therefore a relationship between training and regeneration, leading to superior physical, metabolic and neuropsychological adaptation (see Fig. 1).

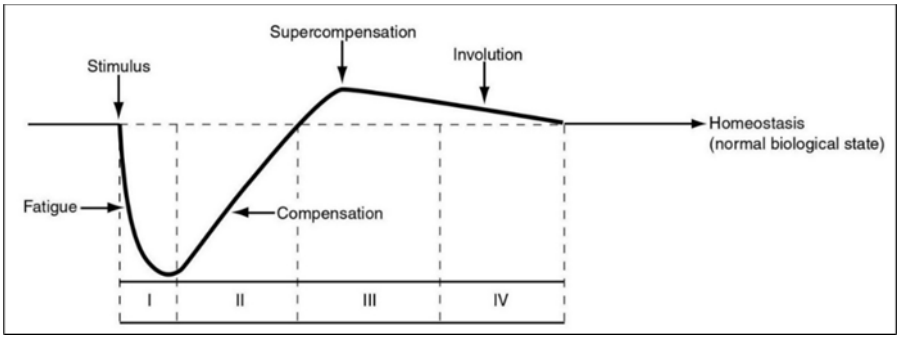

Fig. 1: Supercompensation cycle, taken from N. Yakovlev, 1967, *Sports biochemistry*

It should be specified that adaptations are determined by the physical load as a whole and not by the individual exercise, which is not sufficient to cause significant adaptations.

[1] Training stimulus: is a motor action performed to achieve certain objectives, which can have different characteristics (short, long, continuous, interval, constant, irregular, ...). It can be external (see previously described objectives) or internal (anaerobic, lactacid, lactacid energy expenditure, ...)

[2] Homeostasis: state of dynamic equilibrium of the body's biochemical processes and functions that take place in a continuous constancy of physiological functions (body temperature, blood pressure, ...)

[3] Physical load: set of stimuli that the sportsman or woman carries out according to physical, psychic and intellectual needs, adapting them on the basis of the training aims.

It is, above all, the repetition of stimuli that allows the acquisition of adaptations in a stable form as the achievement of performance capabilities at a higher level.
The body's responses, and therefore the adaptations and modifications that result, will be different depending on the functions involved (intensity, volume, density, frequency) and the energy metabolisms linked to them.
If the stimulus is of short duration (e.g. 10 seconds) but with an intensive load (e.g. weight-lifting), adaptation will occur progressively both at muscular level and in the increase in the capacity of alactacidic anaerobic metabolism, which occurs in the absence of oxygen and without the production of lactic acid. If the stimulus lasts longer (e.g. 120 seconds) with an intensive stimulus (e.g. running 400 metres) there will be an adaptation in the improvement of the lactacid anaerobic capacity; finally if the stimulus lasts longer than two minutes but with a mild load (e.g. swimming 1000 metres), then the aerobic metabolism, i.e. aerobic endurance, will improve.
The work-recovery ratio within the same training unit[4] is very important, if too high then so will be the density and consequently the training will be challenging, if too low it will not provide adequate stimulus. Similarly if an athlete is subjected too frequently to certain types of training then the onset of injury or specificity of adaptations will be evident, if the frequency is low then the stimulus will not be training and will not contribute to performance in the medium to long term.
The phenomenon represented by the different adaptation times of different metabolic and biological systems is referred to as heterochronism, the time to supercompensation.
This time depends on the genetic characteristics of the individual, the level of preparation in the season and the environmental conditions in which the training is carried out (e.g. altitude), but it is essential to know it in order to distribute the loads in the programming of each athlete.
Depending on the size of the load and therefore the energy metabolism involved, there must be an adequate recovery time to be respected so that the training stimulus is effective and not counterproductive: it is in the recovery time, in fact, that the adaptation of the organism and its regeneration to rebuild the necessary energy reserves takes place.
Prof. Carlo Vittori, Pietro Mennea's historic coach, claimed that: ‘Sports training is a complex educational process that takes the form of organising repeated physical

[4] Training unit: it is the smallest unit of the entire training process, it is the set of quantitative, organizational and duration characteristics of the number of repetitions of the training stimulus. It is a closed set consisting of three phases: preparatory phase, main phase, final phase.
Example of training unit: run 100 meters x 6 times x 2 series = 1200 meters.

exercise in such quality, quantity and intensity as to produce progressively increasing loads in a continuous variation of their content to stimulate the body's physiological processes of supercompensation and improve the athlete's physical, psychic, technical and tactical capacities, in order to enhance and consolidate their performance in competition'.

This definition led us to reflect on how the 'coaching process of supercompensation' of the person in its wholeness, complexity and variability, which takes place in an 'organised context' of relationships and actions with a coach, an adult or an experienced peer, can be compared with Lev Vygotskij's concept of the Zone of Proximal Development (ZSP), understood as the distance between the actual level of development and the level of potential development that can be achieved with the help of others.

'The zone of proximal development defines those functions that are not yet mature but are in the process of maturing, functions that will mature tomorrow but are currently in an embryonic stage. The actual level of development characterises mental development retrospectively, while the zone of proximal development characterises mental development prospectively' (Vygotsky, 1931).

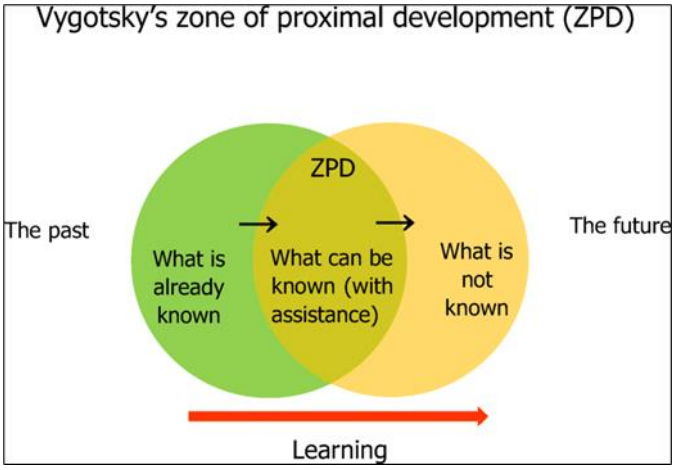

Fig.2: Nomura, N., Matsuno, K., Muranaka, T. *et al.*: "How Does Time Flow in Living Systems? Retrocausal Scaffolding and E-series Time" in *Biosemiotics* 12, 267–287 (2019).

The ZPS represents the area in which one can observe what the child is capable of doing alone and what potential learning is possible when supported by a competent adult (or peer). In this way, an interaction is created between the 'more experienced subject' and the child that leads to learning, through a relational,

developmental and learning dynamic, similar to what happens between coach and athlete.

2. Relations, perspectives and implications for educators (teachers and coaches)

Returning to the objective of our work, we believe it is possible to hypothesize a relationship between development-learning and training-adaptation, based on certain principles and elements characterising the phenomena of ZSP and supercompensation; synthetically, just as in the zone of proximal development the process takes place that leads to a higher level of knowledge, through supercompensation the organism arrives at a better level of psychophysical fitness. The highlighting of this relationship can contribute to the valorisation of the complexity of development and learning processes and of teaching and training, in an ecological-relational perspective consistent with the biopsychosocial models of the ICF (WHO, 2001) and of Capability (Sen, 1985), and supports a transdisciplinary reflection towards new formative and transformative paradigms, in the inclusive direction.

In the Vygotskian view of the relationship between learning and development, learning, which is not development per se, is connoted as an area of potential development and constitutes a source of development. Correct organisation of learning activates processes and leads to mental development, therefore 'good teaching' is only that which anticipates development; teaching activity must take place between the zone of actual and potential development, i.e. in that zone where the learner can construct knowledge (zone of proximal development).

In this framework, school learning orients and stimulates internal development processes and creates the zone of proximal development, but only under certain conditions.

Development and learning do not take place in parallel or even in equal 'measure'. The dynamic relationships between the two processes are very complex and cannot be encapsulated in an immutable theoretical formulation. The same happens in supercompensation: in the face of the training stimulus, a bodily adaptation ensues that places the organism in a better situation from an athletic point of view than the starting one, always taking into account the possible variables. The training stimuli also require specific relational and environmental conditions and presuppose a personalised knowledge of the athletes: they must be adapted to the development levels; only if they respect the times and conditions of each individual do they lead to a better cognitive, psychological and physical condition.

More in detail, Vygotsky's idea of learning activities, as D'Amore Fandiño Pinilla & Marazzani (2004) point out, is refined; it explicitly refers not to generic learning activities, but to problem solving situations, which can be distinguished according to two modes: 'autonomous problem solving', tackled by the learner autonomously, and 'collaborative problem solving', tackled by the learner under the guidance of an adult or in collaboration with a more capable peer. 'What one does in collaboration may not be fully acquired autonomously, but, if collaboration has taken place, then one's doing is part of the potential zone or, at least, serves to define and recognise it (indeed, according to Vygotsky, the results of collaborative problem solving may reveal more about individual competence than autonomous problem solving)' (D'Amore et al., ib., p. 3).

The importance of the child's collaborative contexts with a more able subject (adult or peer) with respect to learning processes, the consequent mental development and the role played by imitation in the interaction represents the essential characteristic in terms of the 'organisation of learning' and the recognition of this characteristic constitutes one of the fundamental tasks that Vygotsky attributed to both psychology and pedagogy (Caprin, Zudini, 2015). Learning by imitation, understood not only as repetitive passivity, but as the setting in motion of autonomous mechanisms on the basis of a proposed winning behavioral model, plays a fundamental role; the centrality of belonging to a society within which the learner is embedded is thus affirmed. 'Human learning presupposes a specific social nature and a process through which children gradually become embedded gradually into the intellectual life of those around them' (Vygostkij, 1934).

In the relational space of ZSP, as well as in that of supercompensation, learning precedes development; individual dimensions are central and unavoidable, but they are realised in a social context, in the relationship with the expert other (teacher/coach) and others (peers) and under certain environmental conditions: an organisation of the learning environment based on collaboration with expert adults or peers and on the mediation of cultural artefacts, languages and tools is necessary.

Language as a means of social exchange plays a central role in learning activities. In educational settings (specifically in mathematics) and collaborative problem-solving scenarios, "when faced with the proposed pre-exercise, the student must establish communicative resonance with either an adult or a more capable peer assigned as a collaborator. The latter assumes the role of a guide, leading the less experienced learner by providing explanations of the resolution process, often delivered in real time" (D'Amore et al., ib., p.8). It is crucial to emphasize that within this educational-relational dynamic, which unfolds against the backdrop of the

knowledge-teacher-student triangle (Develay, 1992; Damiano, 1993), the learner does not occupy a passive or dependent role. On the contrary, within the framework of a complex ecological-relational paradigm, agency is recognized as an essential dimension to be valued.

The mechanisms of the Zone of Proximal Development (ZPD) and supercompensation align with key pedagogical principles acknowledged today in evidence-informed educational research (Hattie, 2009; Trinchero, 2017). As Bonaiuti (2019, p. 53) reminds us, among the findings "that can be reasonably trusted" is the understanding that the human mind must remain active, goal-focused, tends to be easily distracted, and is incapable of multitasking effectively in many cognitive tasks (Hattie & Yates, 2013). Moreover, experts and novices think differently, with the latter requiring more support (scaffolding) in the early stages of learning (Clark, Nguyen & Sweller, 2006; Chen, Fan & Macredie, 2006). Furthermore, as with athletic training stimuli, single exercises are insufficient to provoke significant adaptations in school learning; rather, repeated stimuli—provided under specific conditions—are required for the acquisition of stable adaptations, culminating in higher levels of performance.

It is worth noting that training stimuli are traditionally conveyed through various types of knowledge and languages: verbal, visual, and bodily (gestural, tactile, kinesthetic). These are supported by artifacts, tools, and environments that provide affordances (Gibson, 1979) and by competencies connected to sociocultural practices (Borghi, Gianelli, Lugli, 2011; Rietveld & Kiverstein, 2014). This approach aligns with the enactive perspective of Embodied Cognition applied to education (Damiani, Gomez Paloma, 2019). Beyond school and sports contexts, research into an "expanded" interpretation of affordances is particularly relevant, supporting inclusive perspectives in fields such as psychiatry and intercultural studies. This involves shifting the focus from individuals' symptoms to the affordances of their environments, although studies on how culture modulates affordances remain scarce (Borghi, 2021).

Sannino (2011) highlights the revolutionary impact of introducing cultural artifacts into human actions, transcending the Cartesian division between the individual and the untouchable social structure as a new unit of analysis. "The individual can no longer be conceived without considering them as a creative subject who uses and produces artifacts" (Engeström, 1996, p. 132).

For our analysis, it is important to consider the various interpretations and revisions of activity theory and expansive learning. According to Sannino, it is necessary to move beyond a narrow, biased view of the notion of internalization, still present in many Vygotskian scholars, which relegates externalization and creation to the

margins: “Until emphasis is also placed on transformational initiatives in which the subject engages through their path in society, we will only have a potential subject. A true subject is one who creates, produces, and transforms” (Sannino, ib., p. 108). Such a subject is capable of choice and self-determination, achieving social identity through an “inclusive” educational relationship tied to principles of citizenship and democratic participation for sustainable development (Giaconi, 2012), pointing toward co-development.

As Caruana and Borghi (2011) note, it is essential to recover Vygotsky’s (1978) insight that cognition is the result of the internalization of socially mediated interactions through language (Mirolli & Parisi, 2011). This view is further supported by research initiated by the discovery of mirror neurons and their role in language evolution, identifying gestures as precursors to human language and suggesting that the intrinsically social nature of gestures was transferred to language (Ferri et al., 2011). This underscores the importance of intersubjectivity and multidimensionality in learning and teaching processes.

In this context, the dynamics of ZPD and supercompensation offer intriguing potential for fostering empowering and inclusive processes. Reflecting on their defining mechanisms, the psychological, intellectual, and motor capacity for continuous learning involves adaptation to the surrounding environment combined with the ability to realize, in both mind and body, a cognitive and cultural enrichment unique to each individual. Just as a coach leads an athlete to improved performance through adaptations resulting from training stimuli, so should a teacher guide students toward higher cognitive learning by organizing learning activities, applying diverse teaching styles, and providing multifaceted stimuli. This approach fosters the acquisition of new competencies and advanced knowledge as an adaptive response to the given stimuli.

Pedagogically, it is important to highlight the relational nature and the complex personal, social, and cultural dimensions of learning without losing sight of the individual’s centrality, agency, and self-determination. Learning and training are discovery and construction processes shaped by experience and context, filtered through the perceptions, needs, desires, thoughts, and emotions of both students and teachers. The person-environment dynamic represents the unit of analysis for learning, development, and health, consistent with the biopsychosocial model, which shifts focus to contextual conditions enabling functioning and freedom, aligned with the Capability Approach.

From a neuroscience perspective, the complex mind-body-environment dialectic aligns with Seung’s (2012) connectome theory. He posits that the dense network of neural connections forming the brain—similar to a coral forest—differentiates

individuals because connectomes change over time in response to relationships, experiences, and events, making each person's connectome unique.

In today's context, new interpretative frameworks for the connectome and relational complexity are emerging, shaped by digital environments. These frameworks highlight new forms of agency, relationships, and mediation. Mori (2015) identifies three types of connectomes: neural networks, social networks, and a third form shaped by the current infosphere (Floridi, 2009). This third form reflects the evolving probabilities and models of interaction between humans, the types and numbers of connected objects, and the sense of their interactivity, as well as the datafication of "reality" and life contexts generated by contemporary ICT (Mori, ib. p. 90).

"The material contexts of actions and relationships, including the objects within them, can be conceived and designed to become increasingly capable of subtle, widespread informational interactions with human cognitive and communicative processes. These interactions shape cognitive, proprioceptive, perceptual, mnemonic, and organizational potentials in a space-time characterized by universal connectivity" (ib., p. 91).

Again, according to Mori, it is necessary to recall the treatment of third-order technologies with reference to those artefacts that mediate between other technologies, according to the 'technology - technology - technology' model in which the human user disappears, not because he is absent or completely excluded from technological interactions, but because he is inserted in a space-time - that of the infosphere - in which agency is distributed in a diffuse manner among the 'objects' that surround him, in a different way than in the past.

Recalling the principle of non-locality of quantum physics, in this third form of the connectome, it is not the physical proximity or distance of the elements in relation that matters, but being or not being connected and interacting. In this environment, the new artefacts, increasingly smaller, wearable, 'powerful', connected and pervasive information processing devices, as well as smart spaces, as Mori points out, modify the brain's simulation and emulation activity referred to by Berthoz (2009), consequently modifying both the lived world and the environment accessible to perception, action planning and intersubjective sharing. In this scenario, the characterising elements underlying the development and learning processes in ZSP and Supercompensation (interaction, imitation, cooperation) are the same, but take on new and different forms and phenomenologies that must be understood and 'managed'.

To conclude, let us try below to enumerate some aspects of interest closely related to our initial scope of analysis, which seem to open up spaces for future research into possible implications and applications in education and teaching.

Synthetically, the highlighting of the relations between ZSP and Supercompensation favours the recognition of the role of the context in development and learning processes and, consequently, of the need to plan and organise (design) it in teaching and training activities, through the identification of certain characterising elements pertaining to the dimensions of intersubjectivity and enactivism (interaction/relation, emotion, perception and action, body, movement, cognition and cultural artefacts), which outline multiple, flexible and differentiated evolutionary trajectories, but which highlight fundamental aspects that cannot be renounced for a positive evolution of learning (i.e. one that is an effective source of development): the support of the interconnection environment, mind, body, emotion, relationship and cognition, and the personalised and collaborative educational mediation, through the definition of a device that 'presides over the organisation of times, spaces, the proxemic dimension, the location and management of the bodies of educators and educandi, relationships, activities, methods and techniques, means and tools, symbols' (Riva, 2004, p. 173).

Moreover, the comparison between ZSP and Supercompensation makes it possible to emphasise the key role of cultural artefacts, of the different languages beyond the verbal one (with particular reference to languages linked to corporeity and movement) and of the enhancement of different tools and different contexts, such as sports or outdoor education, but also different in that they are atypical or neurodivergent, through the design and care of new types of affordances to enhance the intervention on contexts.

Attention turns to new physical, mental, cultural and social contexts, tools, mediation processes and the need to explore development and learning processes based on complex dimensions and connections in non-traditional environments. This reflection invites further research into empowering, inclusive, and sustainable pedagogies in the global and digital era.

Finally, this focus fosters reflection on 'new' teaching and training processes and 'new' empowering, capacitating and inclusive didactics in the current and future global scenario. Differences in learning, in the forms of learning, in the forms of connections, find citizenship in the complex and dynamic paradigms of development and learning, and the differences/differentiations in didactics and in the organisation of multiple, flexible and varied learning environments (consistent with the Universal Design for Learning perspective) are not only well-founded, but also indispensable, as they represent the physiological consequence.

Lastly, the issue of the - quality - training of trainers (educators, teachers and coaches) emerges as increasingly urgent and challenging.

3. Experiences

Returning to our subject of investigation and the genesis of its identification, we present below an example of a direct experience from several years ago: F., a 17-year-old high school student and promising water polo player from Reggio Emilia, was left wheelchair-bound in 2001 due to a spinal cord injury caused by a scooter accident. In embracing his new identity, F. decided not only to continue swimming but to train even harder, aiming for a significant goal: the 2008 Beijing Paralympics. Throughout this journey, marked by numerous challenges, F. managed to solidify his athletic mindset, establish a new daily routine, enhance his self-efficacy, and achieve fifth and sixth place in the finals of his competition category. Finding the keys to motor learning in his new condition was not straightforward, and his training was further complicated by fragile health. However, thanks to strong motivation, the ability of his coaches and family to handle unforeseen events, meticulously planned training sessions (ranging from the contextual setup to emotional feedback to stopwatch-recorded timings), and strong empathy between F. and his coaches, the Olympic goal was achieved with immense satisfaction.

In regaining familiarity with his body, the young athlete had to learn to move in water without using his legs, which had previously provided both stability and propulsion. Consequently, the initial focus was on adapting to this new aquatic environment.

Once this aspect was consolidated, the focus shifted to the periodization of training, involving the division of the year into macrocycles (measured in months), mesocycles (measured in weeks), and microcycles (measured in days) for general and specific preparation, competition, and transition. These cycles were typically repeated in a systematic manner.

Without delving too deeply into the technical aspects of the various phases, the volume and intensity of water-based training led to significant improvements in F.'s timed performances. For example, in September, the 50-meter breaststroke was completed in 1’15”, while by the end of the competitive season in August, it was reduced to 55”75, as shown in the table below:

DISTANCE: 50-METER BREASTSTROKE, SB3 CATEGORY

DATE	TIME
10/09/2007	1’15”
08/10/2007	1’12”
08/12/2007	1’14”
07/01/2008	1’08”
20/02/2008	1’10”
09/03/2008	1’05”
20/04/2008	1’01”
19/05/2008	59”98
22/06/2008	58”35
20/07/2008	57”12
08/09/2008 BEIJING PARALYMPICS	55”75

Training contributed to adaptive phenomena, ensuring recovery and enabling F. to maintain and enhance his technical and motor skills. The proper interaction between workload and recovery, the cyclic structure of periodization, and the hierarchy of training cycles generated a performance capacity slightly above the initial levels, due to the application of the theory of supercompensation. The workload imposed by the coach disturbs the athlete's homeostatic balance, temporarily reducing performance capacity. During the subsequent recovery phase, performance capacity improves, surpassing initial levels.

To effectively structure motor learning, which inherently involves trial and error, it is necessary to clearly define objectives, motivate the learner, stimulate curiosity, and provide practical, gestural, and verbal demonstrations to assist in the mental representation of movement, always offering feedback related to bodily perception.

The mental representation of movement occurs in the cerebellum, which memorizes the commanded gesture, the context in which it occurs, and its outcome. With each subsequent repetition, the cerebellum compares the executed movement to the commanded one, selecting the most efficient program and thereby refining the gesture.

A similar process occurs within the Zone of Proximal Development (ZPD). Just as in the relationship between coach and athlete, so too in the teacher-student dynamic, learning organization (context, type of stimulus, frequency, etc.) operates through

comparable mechanisms. Training and learning stimuli determine the magnitude of adaptive responses, which define an individual's sporting performance, skills, and competencies**.**

Conclusions

The experience described above illustrates how individuals, even with different and critical health conditions, can learn at varying levels and contents through interactions with their surrounding environment, both cognitively and physically. We are perpetual learners, constructing our abilities and knowledge moment by moment in relation to the external world, ourselves, and others.

The changes driven by supercompensation and scaffolding within the Zone of Proximal Development are consequences of the interaction between individuals and their stimulating contexts. Learning unfolds over time, interconnecting and leading to higher levels of academic or athletic achievement. This undoubtedly embodies one of the most indispensable and vital conditions for us as humans: our freedom to choose and become what we can and desire to be.

Everything we achieve with effort and emotion depends on who we are, and who we are is built daily through learning, each in their own way, within enabling relational contexts. Freedom is not an a priori attribute; conditions must be created and ensured for it to be realized, in empowering contexts where individual capabilities transform into effective functioning.

Highlighting the relationship between the mechanisms of supercompensation and the ZPD, as outlined in this work, can strengthen educators', teachers', and coaches' awareness of the importance and "empowering potential" (in both learning and functional terms) of their roles.

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