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APPLICATIONS OF NEURODIDACTICS AND MOTOR LEARNING

APPLICAZIONI DI NEURODIDATTICA E APPRENDIMENTO MOTORIO

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Abstract

In the pedagogical field, the search for effective teaching strategies regarding neuroscience and the connection with motor learning have found application and functionality through some computer programs aimed at both adults and young people with the aim of being able to improve cognitive functions and increase them through specifically operational training for the enhancement of attention skills, speed, memory, visual patterns, socialization and intelligence. These objectives can be developed through targeted exercises that use operational strategies related to neurodidactics. In relation to the effectiveness of decision-making processes, this strategy can represent a possibility of empowerment for the individual and translate into a better ability to coordinate the functions of information processing in the motor-sports field.

In ambito pedagogico la ricerca di strategie didattiche efficaci riguardanti le neuroscienze e la connessione con l'apprendimento motorio hanno trovato applicazione e funzionalità attraverso alcuni programmi informatici rivolti ad un pubblico sia adulto che giovanile con l'obiettivo di poter migliorare le funzioni cognitive ed incrementarle attraverso training specificamente operativi per il potenziamento delle abilità di attenzione, velocità, memoria, pattern visivi, socializzazione ed intelligenza. Questi obiettivi possono essere sviluppati attraverso degli esercizi mirati che utilizzano strategie operative collegate alla neurodidattica. In relazione all'efficacia dei processi decisionali tale strategia può rappresentare una possibilità di empowerment per l'individuo e tradursi in una migliore capacità di coordinamento delle funzioni di rielaborazione delle informazioni in ambito motorio-sportivo.

Keywords
Motor Learning; Training; Neurodidactics.
Apprendimento Motorio; Allenamento; Neurodidattica.

Introduction

In recent years, cognitive training has been the subject of studies and research on its validity as well
in the sports context, as it improves the flexibility of cognitive response, increases attentional processes and enhances the speed of execution of performances. The goal of cognitive training is to improve executive functions through targeted exercises, which are usually offered through software and technologies that can be used on computer platforms. It can be used with a rehabilitation purpose, or as an enhancement of cognitive functions in the context of daily life with a preventive purpose, or in the context of some specific contexts, such as sports, with the aim of increasing performance. Cognitive functions are mental processes that allow us to process inputs from reality and to prepare appropriate responses to these stimuli in the form of behaviors, they can be divided into basic cognitive functions and complex cognitive functions. Among the basic cognitive functions, attentional processes should be mentioned. Attention is the ability that allows you to concentrate cognitive resources on some inputs coming from reality (Gola, 2022). Neurodidactics operative strategies connected to motor activities mainly concern the determination of an applicative focus related to this metacognitive aspect (Varela-Aldás et al., 2019). The effectiveness of educational practice and structured training through appropriate didactic progressions can allow the individual a better ability to develop decision-making functions, self-esteem and greater awareness in motor actions (Tino, Fedeli & Mapelli, 2019). Cognitive training uses, as mentioned, mainly computer programs. In practice, it consists of a series of repeated exercises, performed on the computer, which aim to improve basic and complex cognitive functions.

Neurodidactics and Sport

In consideration of the multidisciplinary approach for which the meaning of the term Neurodidactics consists in the ability to project in an effective pedagogical-didactic perspective of the elements that concern not only psychological aspects related to the motivational sphere but also scientific aspects to be framed in the perspective of the pedagogical assumption concrete, concerning the transference of learning, it appears to be current that the direction of neurodidactics can develop towards the study of perceptual-cognitive skills also in the motor field, demonstrating that success in a sport, be it team or individual, also requires and above all the ability to process information and the speed in adapting to the rapid changes of the context during competitions, both in terms of complexity and situations (Schafer, 2020; Oliverio, 2018; Gola, 2021). For example, a player in a group sport must have the ability to constantly monitor game situations and the movements of the opponents, make decisions quickly, adapt them to the present context and have the ability to modify them if variables around him change. He must have good attention, good memory skills, good strategic skills and inhibition of automatic responses, which could instead lead to making decision errors (Nicolosi, 2015; Rivoltella, 2018; Sala & Gobet, 2019). Considering these aspects, therefore, cognitive abilities become almost more important than physical ones, significantly affecting the performance of the athlete and consequently the success of the group. Given these premises, it is plausible to think that sports activities from early childhood should pay particular attention to the development of these functions, because contributing to their increase allows for improved performance

(Bellantonio, 2020; Cappuccio & Compagno, 2015). Speed, the ability to anticipate or predict the opponent's moves, adapt to a dynamic context, are all variables that can play a fundamental role in the outcome of a match, as well as the ability to concentrate. Motor performance, therefore, is strictly connected to the development of executive functions; motor activity in itself represents an excellent way to encourage and implement them: it is therefore clear that structuring exercises that are aimed at achieving specific objectives can be important for the development of athletes and that the acquisition of certain skills could also be useful in a broad logic of sharing training areas.
In the development of activities concerning the aspect of neuroscience in synergy with the use of a didactic aimed at enhancing the playful dimension of the development of multiple intelligences, the deepening of multidimensional cognitive training can represent an operational strategy useful for enhancing some specific related aspects to the attentional abilities of the individual. In a similar way to how we can train our muscles in their various characteristics, relative to the conditional capacities of strength, speed, power, and elasticity, we are able to develop and exercise our brain and its qualities, both from a point of view physical, increasing vascularity, synaptic connections, neurogenesis, and psychological (Federici & Toscani, 2018; Torregiani, 2017). This idea stems from the basic concept of neuroplasticity, a key aspect in neuroscience, indicates the ability of the brain and the entire nervous system to modify and optimize its structure at any age, in response to a variety of intrinsic and extrinsic factors. It is therefore possible to propose solutions capable of specifically training the personal cognitive abilities of everyone, improving their performance level, for general well-being or for specific sports and work gestures and behaviors. The functional applications of Brain Training, specifically of the Brain Hq program, are able to train different cognitive skills and are structured on hundreds of levels, with different complexities according to the capabilities of each individual. In fact, each user is profiled and monitored throughout his training path, and the program is automatically defined and modified according to the level of skill reached in order to always keep training at the right level so that his skills can continue to evolve. The program agenda allows you to view the subject's training status, how much he has trained, his progress and the level of performance achieved compared to the average of the individual-user universe of the same category. The application functionality offers multiple exercises specifically aimed at training different cognitive abilities divided, in the list below, into 6 main categories, for each of which different exercise possibilities are developed. They are described in the following points:

- Attention.
- Speed.
- Memory
- Socialization
- Intelligence
- Orientation

Experimental design in the field of physical and sports education

According to some authors, motor and sports education classes are a promising place for the use of exergame in education (Yang, Smith & Graham, 2008; Casolo & Frattini, 2021). In the

United States, computers and consoles are already present in the school system, with nearly half of students claiming to use video games to carry out an assigned educational activity (Lenhart et al., 2008), and some exergames have been introduced into the engine and curricula of sports education (Sgrò, 2014; Schmidt et al., 2018; Ascione & Di Palma, 2021). However, it is important to remember that the aim of this contribution is not to propose exergames as substitutes for the current proposal for Motor and Sports Education but, like any other type of technology, it aims to consider them as complementary tools for effective teaching. that contains elements capable of synergistically improving cognitive and motor skills (Soltani, Figueiredo & Vilas-Boas, 2021; Lucariello & Tafuri, 2018). In this regard, an experimental project in the pedagogical-didactic field is described, implemented in a classroom context of the lower secondary school to evaluate the efficacy and effects in the practice of an educational program of motor and sports teaching that provides for the combination of traditional methods with the use of exergame in synergy with cognitive training programs (Kojic et al., 2019; Ferrara, 2012). It is essential to state that the experimentation was based on the collaboration and expertise of the motor and sports education teacher of 8 sample class, which was the object of the applications of Neurodidactics and Motor Learning strategies.
Didactic Discipline: Motor and Sports Education.
The sample consisted of 176 students of a first grade educational institution: 77 males (M) - 89 females (F) - average age: 12.6 years.
A subdivision into 2 homogeneous groups was carried out by gender and starting level:
Experimental Group: 39 M - 49 F; Control group: 38 M - 50 F. Software used: Brain Training Nintendo Switch- Brain Hq- Your Shape Fitness Evolved. (4 hours x software).
Duration: 3 Months - 2 Weekly Lessons of 1 hour each - For a total of 24 Lessons (24 hours).
The Experimental Group has included, in its educational program, the use of exergames and brain training software for 50% of the lesson hours through a didactic strategy that used a directive didactic strategy of the skating station. In the meantime, the Control Group has carried out the traditional Motor and Sports Education program.
The Evaluation Protocol used, structured in collaboration with the teacher who also had previous knowledge of the entire sample, is summarized in the following scheme and is contextualized to the grade and academic year of the class taken as a research sample.
The protocol provides for 3 levels of judgment in ascending order, from the first to the last. In synergy with the teacher, 2 evaluations were carried out: the first at hour 0 (before the start of the quarterly project) and the second at the end of the project, both for the experimental group and for the control one, in order to monitor the educational development of students in both cases. In relation to the number of absentees who for various reasons lost 8 hours, which were 20 in both groups, for the lessons in the control group on a total of 77 students, 43 showed an educational growth thanks to the traditional teaching plan (55,84%), while in the experimental group on a total of 79 students, the project including the use of software allowed 48 students to achieve educational development (60.75%).

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Graph. 1 - Evaluation Results

FOUNDING NUCLEI	**THE BODY, ITS EXPRESSIVENESS AND THE CONDITIONAL SKILLS**		**THE SENSORY PERCEPTION, THE MOVEMENT AND ITS RELATIONSHIP WITH SPACE AND TIME**		**GAME, GAME-SPORTS, SPORTS**	
SKILLS	Performing motor activities by adapting to different contexts and expressing actions through gestures.		Using perception stimuli to achieve the required motor action in a suitable and effective way.		Knowing and practicing, in the correct and essential way, the main sports games and individual sports	
KNOWLEDGE AND SKILLS	**Knowledge**	**Skills**	**Knowledge**	**Skills**	**Knowledge**	**Skills**
	Knowing the potentialities of the movement of one's body, the correct postures and the physiological functions. Recognizing the rhythm of actions and the difference between functional and expressive movement.	Developing effective and personal motor responses in simple situations. Taking correct postures at natural load carriage. Seizing rhythmic differences in simple motor actions.	Knowing about the system of motor skills that underlies motor and sports performance.	Having awareness of an effective and affordable motor response. Managing the start-up phase independently according to the chosen activity.	Knowing about the essential aspects of sports terminology, regulation and technique.	Knowing about and practicing essential sports games and some individual sports in an essential and correct way.
STANDARD	Being aware of the morphological and functional body changes. Expressing oneself through technical gestures		Controlling and adjusting the movements referred to oneself and the environment to solve a motor task, by using sensory information.		Performing the technical gestures in a simplified game situation by respecting the rules, covering different roles (i.e. a referee) and recognizing	

			the value of the competition.
LEVEL 1	Sufficiently implements the adaptations referred to a habitual motor activity and to elements belonging to a tested field	Sufficiently recognizes various sensory information and controls the gesture in relation to spatial - temporal changes	Knows sufficiently the rules and techniques of practiced sports and participates with fair play, by also facing arbitration functions
LEVEL 2	Performs different motor actions, correctly uses proposed models by testing his skills even in experimental settings	Can identify sensory information by implementing correct motor responses while respecting movement dynamics.	Knows the tactics and possesses good skills in various sports activities, showing fair play and respect for the rules
LEVEL 3	Shows excellent knowledge and realizes different motor activities in a harmonious way adapted to the situations	Can optimally adjust the dynamics of the movement by using perceptual information, performing motor gestures with synchronized movement.	Shows tactical confidence, fair play and excellent skills in the practice of various sports activities

Tab.1. Protocol of Evaluation

Conclusions

The conscious, targeted and organized, use of computer programs dedicated to cognitive training during motor and sports education lessons can represent an innovative component for the educational proposal of the school system (Rivoltella, 2012; Monacis & Colella, 2019). The experimentation carried out is fully consistent with the studies analyzed on the subject, and favors the use of brain training programs in teaching as a tool for the development of learning and training in the school system. The definition of the main categories of the exercises contained in the brain training programs described have the aim of implementing the integration between the different sensory stimuli coming from the environment, and, in synergy with the training, they may be able to improve the execution of the motor act (Compagno & Di Gesù, 2013; Cassese, 2021). The application functions of neurodidactics in relation to applicative motor learning to reduce processing times, linked to the stimulus-response process, in the context of cognitive response flexibility, increase attentional processes speed and try to enhance performance execution, and it can represent an effective empowerment strategy also linked to an improvement of the individual's relational skills. It is evident that the proposal to combine this technological tool with the traditional didactic approach of motor and sports sciences can lead to a more effective educational action of the school system. This contribution constitutes a solid basis for the development of future empirical research to evaluate the effectiveness, in the medium-long term, of the exergames and of the related educational and didactic strategy that optimizes their adoption in the contexts of the educational system at all levels.

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