NEUROEDUCATION: THE IMPORTANCE OF TRAINING TO BECOME AGENTS OF CHANGE IN THE SCHOOL SETTING

NEUROEDUCAZIONE: L'IMPORTANZA DELLA FORMAZIONE PER DIVENTARE AGENTE DI CAMBIAMENTO NEL CONTESTO SCOLASTICO

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Double Blind Peer Review

Citazione

Liparoti M., (2023) Neuroeducation: the importance of training to become agents of change in the school setting, Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva - Italian Journal of Health Education, Sports and Inclusive Didactics. Anno 7, V 2. Supplemento Edizioni Universitarie Romane

Doi:
https://doi.org/10.32043/gsd.v7i2.940

gsdjournal.it
ISSN: 2532-3296
ISBN: 978-88-6022-479-8

ABSTRACT

Neuroeducation has proven to be a fundamental practice for understanding the functioning of the human brain and applying its principles to the educational setting. This paper aims to explore the importance of neuroeducation training, as an agent of effective change in the educational setting. To this end, have been analysed the effects of neuroeducation on both teacher and learner training and its pivotal role in promoting educational equity.

La neuroeducazione si è rivelata una pratica fondamentale per comprendere il funzionamento del cervello umano e applicarne i principi all'ambito scolastico. Questo saggio mira ad esplorare l'importanza della formazione in neuroeducazione, come agente di cambiamento efficace nel contesto educativo. A tal fine, sono stati analizzati gli effetti della neuroeducazione sia sulla formazione degli insegnanti che degli allievi, ed il suo ruolo chiave nel promuovere l'equità educativa.

KEYWORDS
Learning, Teaching, Brain, Education;
Apprendimento, Insegnamento, Cervello, Educazione;

Received 19/08/2023
Accepted 19/09/2023
Published 26/09/2023

Introduction

In recent decades, society has evolved significantly and posed new challenges to education. Globalisation, rapid technological advances and the changing demands of the world of work, have necessitated a change in educational approaches. Current society demands increasingly efficient education aimed at the comprehensive and global development of individuals. In this perspective, neuroeducation has emerged as key practice for understanding the complex functioning of the human brain and applying its principles to the school environment.

Neuroeducation combines concepts from neuroscience with education, developing teaching strategies that are effective in stimulating the brain of students and facilitating the learning process (Bruer, 1997). Neuroeducation based on the discovery that the brain architecture is a plastic, capable of continuously adapting and changing according to experiences and the environment (Ansari, 2012). Knowing how the brain functions affects the way students learn. This new approach emphasises the importance of personalising education according to the individual needs of students, and allows for the identification of methodologies that maximise the effectiveness of learning, adapting them to the different needs of students, leaving behind the traditional view of education as a static process, in which students memorise information without real understanding.

Applying the principles of neuroeducation in the modern school context is an effective and extraordinary agent of change. Thanks to advances in our understanding of how the brain works, neuroscience has offered new tools and approaches to improve learning and teaching.

Teaching strategies based on neuroscientific knowledge can improve learning effectiveness, increase student participation and promote greater motivation for academic success . The importance of training in neuroeducation lies in its ability to provide educators with a sound scientific basis for making decisions regarding teaching strategies. Training in neuroeducation can provide teachers with the necessary skills to create a learning-friendly environment in which students feel safe and supported. This can be achieved through the application of techniques such as mindfulness, integration of the arts in the classroom and the use of emotional regulation strategies.

A central aspect of neuroeducation is the awareness that learning is not only a cognitive process, but also involves emotions (Fragkaki et al., 2022). Emotions in fact influence brain activity and can facilitate or hinder learning. Research has

shown that stress and negative emotions can interfere with learning and memory (Tyng et al., 2017). Teachers, therefore, should take students' emotions into account and adapt their teaching approach accordingly. Awareness of emotional reactions and strategies to cope with them can help students cope better with stressful situations and improve their emotional well-being (Ashkanasy & Dasborough, 2003). This in turn promotes a positive school climate and optimal learning. Therefore, creating a positive learning environment and supporting students' emotional management is essential to foster successful learning. A friendly and stimulating physical space can help create a favourable state of mind for learning. Furthermore, the integration of neuroscience-based pedagogical strategies, such as active learning, can increase students' motivation and enhance their learning experience (Baena-Extremera et al., 2021).

Neuroeducation can also be useful in understanding and addressing difficulties in learning and cognitive development, contributing to the reduction of educational inequalities. For example, knowing students' individual differences at the neurocognitive level can help teachers tailor teaching to each individual's specific needs, thus providing a basis for early detection of possible learning disorders, allowing targeted intervention strategies to be designed. This means that students with learning difficulties or different learning styles can benefit from targeted teaching to help them reach their full potential. Another key point of neuroeducation is the focus on students' learning rhythms. Neuroscience has shown that each individual has a unique learning rhythm and that it is important to respect and adapt to this rhythm. This means providing differentiated learning times and strategies to meet the different needs of students. With this in mind, neuroeducation can also help address learning disorders. Neuroscience has made it possible to better understand the biological causes of disorders, such as dyslexia or attention deficit and hyperactivity disorder (ADHD), and this offers new opportunities to adopt targeted teaching strategies and interventions to improve the performance of affected students (Liparoti, 2022a).

Another potential of neuroeducation concerns the development of students' metacognitive skills. Neuroeducation can provide a deeper understanding of the neural basis of metacognition. Research has shown that metacognitive monitoring and control processes involve the prefrontal cortex, a brain region involved in planning, self-control and reflection (Lai, 2011). The relationship between neuroeducation and metacognition is deep and reciprocal. Neuroeducation provides a sound scientific basis for understanding cognitive processes and the most effective pedagogical approaches. At the same time, metacognition enables the individual to develop a self-awareness of his or her own cognitive abilities and

to apply active and conscious learning strategies. Neuroeducation can stimulate metacognition through the use of targeted teaching strategies. For example, the teacher can introduce activities that encourage students to reflect on their own cognitive process, express their learning strategies and evaluate the effectiveness of these strategies. The relationship between neuroeducation and metacognition emphasises the importance of awareness and reflection as fundamental components of the learning process. Through this interaction, teachers can develop effective pedagogical strategies that foster autonomy and responsibility for the learning process.

However, it is important to emphasise that neuroeducation cannot be the only tool to improve the education system. Other factors must also be considered, such as school policies, resources and teacher training. Neuroeducation can make a significant contribution, but the integration of all these elements is essential for quality education.

This article aims to provide a perspective on neuroeducation as a new learning science and agent of change in education. This article aims to provide an overview of the neuroscientific concepts underlying the concept of neuroeducation and to explain why it is important for educational practice. To this end, firstly, the paper sets out to analyse the relationship between the brain and learning. Next, arguing for the importance that the basic principles of neuroscience should be included in teachers' training and should be part of their knowledge base, the neuroeducation training of teachers was analysed and how this can offer them a new perspective to reflect on their pedagogical approach and professional experience, and consequently on the way they teach. Finally, the effects of neuroeducation in terms of educational outcomes were analysed and how neuroeducation plays a key role in promoting educational equity.

1. Exploring the link between brain and learning

To understand the importance of training in neuroeducation, it is crucial to examine the link between the human brain and the learning process. Neuroscientific research has shown that the brain is plastic and constantly changes in response to the environment and stimulation. The basic principles of neuroeducation are based on this premise, focusing on the adaptability of the brain and the importance of positive educational experiences to foster learning.

The brain's ability to adapt and change its structure and function in response to environmental stimuli, cognitive demands or behavioural experiences is

remarkable. This phenomenon, called neuroplasticity, has been extensively studied in several disciplines (Li et al., 2014).

Through the use of brain imaging techniques, such as functional magnetic resonance imaging (fMRI) or magnetoencephalography (MEG), it has been possible to show how the human brain structure is susceptible to experience-dependent changes. The effects of experience on brain morphological evolution has been extensively studied in animal models, and such findings have opened up new research perspectives in humans (Mandolesi et al., 2017; Petrosini et al., 2009). Indeed, it is currently possible to study the relationship between structural and functional changes in the brain and learning in humans. This represents an important research milestone since the study of the relationship between brain changes on different time scales and behaviour prove crucial in cognitive development throughout the lifespan. Through the study of brain anatomical changes that depend on the humans experiences, it is possible to deepen our understanding of the mechanisms underlying these interactions, providing, for example, a more precise basis for concepts such as cognitive reserve or maintenance of brain function. Although microstructural changes in individual brain cells cannot yet be easily explored at present, imaging studies of changes at the macrostructural level of the brain provides a unique perspective on human learning and development. The ability to form and strengthen new connections between neurons in response to different stimuli and cognitive activities contradicts the previous idea that the brain is a static and unchanging organ, on the contrary, its activity is extremely flexible and dynamic (Sorrentino et al., 2021).

In children, the cerebral cortex development is characterized by a great synaptogenesis activity, a phenomenon that contributes to cortical plasticity based on experience during childhood (Chan et al., 2016). Synaptogenesis begins in the occipital cortex in the early postnatal period, reaching about twice the intensity of that in the adult brain by the age of 2 years, and then decreasing in the adolescent period. Similar phenomena of synaptogenesis occur in the parietal-temporal and frontal regions, peaking around adolescence in the case of the frontal lobes. Following a longitudinal study conducted by MRI on a sample of children aged 7 to 19 years, findings emerged regarding the measurement of cortical thickness. A trajectory characterized by an early increase in brain thickness followed by later thinning was observed. In children with high intelligence, the cortex exhibit greater plasticity, characterized by a more pronounced synaptogenesis activity, followed by a more prolonged period of cortical thickness increase, especially in the prefrontal cortex, than in children with average or low intelligence (Shaw et al., 2006). Recent evidence has shown that neurogenesis persists beyond the fetal

period and into adulthood in specific areas of the brain, including the subventricular zone of the lateral ventricles and the subgranular zone of the dentate gyrus of the hippocampus (Toni et al., 2008). These results support the hypothesis that a prolonged period of synaptogenesis during childhood contributes positively to brain adaptive capacity and consequently to better learning ability. For this reason, it is important to implement actions aimed at developing cognitive skills as well as fostering developmental learning processes.

A key role in promoting brain plasticity is played by “enriched experiences”(Kolb et al., 2017). They refer to a stimulating environment full of opportunities and cognitive challenges that can promote brain growth and development. These experiences may include learning a new language, performing physical or artistic activities, reading books, or exploring new territory. Studies have shown that enriched experiences can positively influence brain plasticity. For example, constant practice of an activity can lead to increased synapses in brain areas involved in that specific skill. Brain plasticity also allows the brain to recover from injury or damage. Through reallocation of brain function, undamaged areas can take over the functions of damaged areas. This is particularly evident in cases of head trauma, where the brain can reorganize itself to recover some impaired functions. Enriched experiences can help prevent neurological diseases such as Alzheimer's and age-related cognitive impairment. Studies have shown that people who engage in mentally stimulating and challenging activities are less likely to develop these diseases. This suggests that exposure to a variety of enriched experiences can improve cognitive reserve and delay age-associated cognitive decline. Brain plasticity and enriched experiences are also important for learning. They are the reason why children can learn new skills and acquire knowledge so quickly. Enriched experiences provided during childhood can have a significant impact on cognitive development and long-term learning. These can also foster the development of social and emotional skills. Interaction with other people in complex social contexts can stimulate the formation of new neural connections involved in empathy, self-control, and understanding others' emotions. However, it is important to emphasize that not all enriched experiences are the same either. It is necessary for activities to be age- and ability-appropriate for the individual to maximize the benefits on brain plasticity. We can improve our cognitive abilities by modulating brain networks through training and interventions, which can be targeted for improvement in tasks similar to the one trained or in tasks significantly different from the one trained (Kirk et al., 2015). Brain plasticity and enriched experiences offer multiple opportunities to improve people's quality of life.

Therefore, supporting and promoting access to enriched experiences is critical to individual and collective well-being, especially in the school context.
Although current learning in the school setting has countless advantages, this could be improved if the environment were enriched with the same sensory and motor information that is available in a natural setting, which is more like a real-life context (Mathias & Kriegstein, 2023). Regarding the enriched environment for example, Maria Montessori emphasized the role of hands-on experience with useful objects and learning materials to encourage the integration of multiple senses during learning. In addition, several studies encourage the integration of movement into the learning experience.
Several factors could negatively affect brain activity and consequently lead to problems in the learning process and concentration. These factors are the following: lack of sleep, fatigue, metabolic and energy problems, puberty, gender differences, nutrition, mood problems, aggression, anxiety. All these factors could have a strong impact on academic achievement. For this reason, educational interventions aimed at improving the management of these factors and preserving the possibility of peaceful learning have been planned in recent years. These educational interventions based on the stimulation of active engagement help to optimize information processing, focus attention and sustain concentration, positively affecting study motivation and school performance.

2. Training in neuroeducation for teachers

Training in neuroeducation can provide teachers with an opportunity to gain knowledge and skills needed to adapt their teaching practices to meet the needs of individual students. Training courses in neuroeducation can introduce teachers to techniques and strategies that promote effective and engaging learning. This training can also help them understand the challenges students face and how they can adapt their approach to ensure an inclusive learning environment (Dubinsky et al., 2019). From this perspective, training in neuroeducation can be understood as an important agent of change in school settings.

Neuroscientific findings are potentially useful for understanding the mechanisms underlying learning processes, including language, reading, arithmetic, and other cognitive functions (Tokuhama-Espinosa & Nouri, 2020). Although very interesting, these findings do not offer easy insights applicable to the field of education. In fact, very little research has been the source of innovations in teaching or useful

directions for day-to-day classroom management. However, neuroscientific insights and knowledge could support teachers in their pedagogical approach by expanding the of learning mechanisms. Neuroscientific insights could help answer important questions, such as what factors influence the selection, consolidation, and retrieval of information from the environment? How does the brain learn from mistakes? How does information processing occur and how can this process be improved? What are the optimal conditions for learning? How does the brain develop and how can educators improve this process?

Training in neuroscience is very important from a pedagogical perspective because it appears to influence teachers' choice of instructional strategies to be implemented in the school setting. For the training of education professionals to be effective, it is crucial that curricula be developed by adopting a multidisciplinary approach. A multidisciplinary approach, helps teachers become competent in neuroscience, helping to develop reflective evaluation of knowledge and adopt a critical-reflective teaching method (Bergmann et al., 2017). Several studies have examined the impact of this training on teaching practice and have found an increase in the use of student-centered pedagogical practices, as well as an enrichment of school content with neuroscience knowledge, also influencing the teaching strategies used by teachers (Anderson et al., 2018; Roehrig et al., 2012). This improvement in teaching in school settings as a result of neuroscience training could result from increased awareness of content acquired through neuroscience training. In fact, teachers reported having a better understanding of the relationship between brain functioning and pedagogical practices. This new perspective, could help teachers evaluate instructional decisions in the classroom, facilitating the adoption of constructive approaches that integrate new knowledge with existing knowledge. This could prompt teachers to adopt evidence-based strategies instead of ineffective alternatives. In conclusion, the body of evidence suggests that providing teachers with an understanding of how learning occurs in the brain may foster interest in more effective pedagogical and instructional strategies. All of this highlights how training in neuroscience is an important agent of change in school settings.

In particular, educator training should pay special attention to executive functions (Liparoti, 2021; Liparoti et al., 2019; Montuori et al., 2019). Among the various brain functions that play a key role in learning processes and have received considerable interest in the educational field are executive functions. The latter, are fundamental to three main processes such as: working memory (the ability to hold information in a temporary memory), inhibitory control (the ability to inhibit responses), and cognitive flexibility (the ability to switch between tasks). In addition, the construct

of executive functions underlies different aspects of attention, such as focused and sustained attention. It is inferred how important executive functions are for the individual to learn, to keep relevant information in mind while inhibiting unnecessary information, for personal growth in childhood and adolescence. If we consider executive functions in their broadest meaning, other important skills that depend on the integrity of executive functions are: self-awareness, self-regulation, the ability to handle social dynamics, the ability to recognize and manage emotions, and planning and managing priorities. Therefore, it goes without saying that executive functions are important for education. The study of executive functions can help teachers better understand the students in their class, their behaviours and their individual differences (Liparoti, 2022b). For effective teaching, teachers must be aware of how to get students' attention, how to inspire them, and how to support self-awareness and self-regulation, which are necessary for study motivation and academic achievement. Teachers must have the tools and experience to alert students, help them select the most relevant information, resist distraction, and encourage them to stay on task. In addition, teachers must have the know-how to help students organize and prioritize the execution and planning of tasks and to support personal growth.

Some components of executive functions, such as self-reflection, self-regulation, empathy, social monitoring, mental manipulation, cognitive flexibility, planning, and problem solving, develop over the long period of childhood and adolescence; however, for the optimal development of these functions, it is crucial that the external environment provides the necessary support and inspiration for the person who is learning. It is therefore of great importance in the educational field the role played by the teacher.

Although neuroscience makes a fundamental contribution to teacher training, it does not provide exact rules on the basis of which the right teaching style can be shaped. On the contrary, a background in neuroscience helps the teacher to better manage individual diversity with a view to inclusive teaching. With this in mind, it is important to ask what teachers should know about the field of neuroscience in order to improve the teaching/learning process. An answer to this question was provided by a study by (Tokuhama-Espinosa & Nouri, 2020) who, based on previous research by the International Delphi Panel, established the six principles a teacher should know, which are:

- the brain is made up of a unique combination of genetic factors and life experiences;
- every individual's brain is differently predisposed to learning;
- previous experiences influence new learning;

- there are constant changes in the brain due to experience;
- neuroplasticity occurs throughout life, although there are differences according to age;
- the memory and attention systems are essential for learning;

3. Application of neuroeducation in the school environment

Once teachers are trained in neuroeducation, they can apply the principles learned to the school context, thus creating an optimal learning environment. This includes designing activities that stimulate different areas of the brain, thus promoting integrated learning. In addition, teachers can use advanced technological tools to support students' cognitive performance and encourage their active participation. Educators create conditions for the acquisition of knowledge and experiences that contribute to the development of our learning brains, as well as stimulate and guide students' process of curiosity and information processing. This emphasizes the importance of teachers, parents and other educators in the process of individual development.

How can the teacher make use of neuroscientific knowledge gained in the school setting? One way that will be considered in this paper is the approach involving active learning in an enriched environment.

Active learning is a fundamental approach in education, as it enables students to develop a deep and lasting understanding of the concepts they learn. Instead of just memorizing information, students are involved in hands-on, engaging activities that put them at the center of the learning process. It promotes interaction between students and teachers, fostering a collaborative learning environment (Minino & Liparoti, 2023). Students learn to communicate, work in groups and share ideas, thereby increasing their social competence and problem-solving skills. One of the main benefits of active learning is the acquisition of critical skills. Students learn to think critically, evaluate information, and make informed decisions. These skills are essential for success in life and career, as they enable individuals to adapt to change and make decisions based on careful reflection. Active learning also fosters the development of problem solving skills. Students learn to tackle complex challenges, identify problems and seek innovative solutions. These skills are critical to solving real problems that students will encounter in their daily lives and in their future jobs. In addition, active learning fosters student motivation. Students are more engaged and motivated when they are actively involved in the learning process, rather than being passive spectators.

It gives students the opportunity to have direct experience, experiment and practice what they have learned, thus increasing their interest and motivation. Another important aspect of active learning is that it enables students to develop autonomy. Students learn to take initiative and responsibility for their own learning. This skill is critical for adult life, as it enables individuals to be proactive and pursue their own goals. This approach also contributes to the integration of theory and practice. Students have the opportunity to apply what they have learned in real-world contexts, increasing the relevance and meaningfulness of the knowledge gained. This helps students better understand concepts and bring out the connections between different disciplines. Another benefit is that it fosters students' creativity (Liparoti & Minino, 2023). Students are encouraged to think divergently, explore different solutions to problems and find new ways to approach challenges. This stimulates their creativity and ability to think outside the box. Students in this way become protagonists in their own learning journey, feeling more confident and motivated because they are actively involved in the learning process, rather than being mere recipients of knowledge imparted by the teacher. This increases their sense of responsibility toward learning and makes them more aware of their own abilities and potential. Active learning also promotes diversity and inclusion; it encourages the participation of all students, creating an inclusive environment where everyone can express their ideas and opinions. Students with different cultures and life experiences can contribute significantly to the learning process, bringing unique perspectives. Another relevant aspect of active learning is that it promotes curiosity and passion for learning. Students are motivated to explore new topics, ask questions and seek answers. This stimulates their curiosity and thirst for knowledge, making learning a fulfilling and meaningful experience. So, it promotes lasting learning and transferability of knowledge. Students learn to connect what they have learned in different situations and make connections between different disciplines. This makes learning more meaningful and helps students retain and apply their knowledge over time. Importantly, active learning requires an active role on the part of teachers. Teachers must create a stimulating environment and support students in their learning journey. They must provide clarification, guide activities, and encourage the participation of all students.

The creation of an enriched environment in the school environment is of considerable importance for the learning process of students. The environment and its constitution represent a potential opportunity in which the individual creates and adopts differentiated patterns of behaviour that will change both his or her brain structure and functioning. Such an environment includes various components, such as special learning materials, extracurricular activities,

welcoming and stimulating spaces, and digital resources. The first studies on the effects of an enriched environment were carried out on the animal model (Mandolesi et al., 2017). The use of these models allows us to obtain a direct, concrete and tangible measure of environmental factors that can shape neuronal circuits. The enriched environment is an experimental model in which an animal is exposed to a combination of experiences, such as intense motor activity and prolonged cognitive stimulation, for a certain period of time (Mathias & Kriegstein, 2023). Firstly, an enriched environment offers students the opportunity to explore and learn in a more interactive way. Thanks to the presence of special teaching materials, such as science labs, digital textbooks and educational software, students can experience abstract concepts concretely and explore topics in a more engaging way. This kind of hands-on learning fosters understanding and retention of information, allowing students to develop critical skills needed to tackle real-world problems. Secondly, an enriched environment offers a wide range of extracurricular activities that enrich students' lives outside the classroom. Whether it is sports, art, music or interest clubs, these activities allow students to develop social skills, learn to work as a team and discover personal passions. Students participating in these activities develop soft skills that go beyond pure academic learning, preparing them for real-world challenges. In addition, an enriched environment includes welcoming and stimulating spaces that foster creativity and interest in learning. Comfortably furnished and colourful classrooms with spaces dedicated to collaborative learning and artistic expression create a positive atmosphere that encourages students to explore and discover. Flexible and adaptable spaces can be easily adapted to the specific needs of classes, allowing teachers to adopt different pedagogical approaches and engage students more actively. Finally, an enriched environment offers a wide range of digital resources that enhance students' access to information and research skills. The use of technologies such as computers, tablets and Internet connection allows students to access an almost infinite amount of educational resources and experiences. They can consult online books, participate in webinars, collaborate with students from all over the world and use specialised software to develop specific skills. This immediate and continuous access to information allows students to learn independently, improving their problem-solving skills and digital literacy.

Thus, training in neuroeducation helps teachers to become aware that the plastic properties of our brain, develop and enhance from experience and context. This is crucial for planning interventions in environments that offer different opportunities for exploration and growth, paying attention to the relationship between cognition and emotion (Albanese, 2022). The above makes it clear how important inter- and

trans-disciplinary teacher training is for an effective teaching and learning process (Sibilio, 2020).

4. The positive effect of neuroeducation on student achievement

Several studies have demonstrated the effectiveness of neuroeducation in improving student achievement. The use of techniques introduced by neuroeducation, such as positive reinforcement and emotion-based learning, can help increase students' motivation, attention and interest, promoting deeper and longer-lasting learning. Training in neuroeducation, therefore, can be a significant agent of change in improving student experience and achievement.

Indeed, an educational style that embraces the principles of neuroeducation can improve performance in certain skills, such as literacy, numeracy and social, emotional and moral skills, which are considered essential for the functional development of the individual and other skills (Agbedahin, 2019). Literacy facilitates the understanding of reality, the construction of knowledge and facilitates self-regulation processes. One of the pillars of education is mathematical competence that enables the acquisition of organisational and reasoning skills useful for easy problem solving. Finally, social emotional competence plays a key role in managing emotions, in the expression of behaviours that underpin effective social relationships, and in the development of the capacity for self-awareness and self-criticism.

A study by Cabarello et al. observed an improvement in reading and mathematical skills and in empathy attributed to neuroeducation (Caballero & Llorent, 2022). These results reinforce the idea that effective teaching should include the principles of neuroeducation.

Over the past few years, the fields of neuroscience and neurodidactics have shown significant progress in improving the teaching and learning process of various subjects, including physical education. These advances have been reflected in the scientific literature through interesting studies on students' motivation processes and the effect of physical activity on the brain. Some of these studies have explained how physical activity can influence both psychological and neuroscientific aspects of learning. Furthermore, recent research has shown a close correlation between physical education lessons and future academic success. The relevance of an active teaching process involving active student involvement is therefore evident. Active learning plays a crucial role in education, as it promotes deep understanding, critical thinking and problem solving, motivation, autonomy,

integration of theory and practice, creativity, diversity and inclusion, curiosity and passion for learning, and lifelong learning (Baena-Extremera et al., 2021; Liparoti & Minino, 2023b). Teachers and education leaders should encourage active learning to ensure an effective and meaningful teaching and learning process for all students. It can be inferred that approaching motor skills from a pedagogical and integrative perspective fosters highly effective learning for students, thus contributing to their psycho-pedagogical and developmental development.

5. The role of neuroeducation in promoting educational equity

Neuroeducation can not only improve student achievement, it can also help promote educational equity. Through its focus on individual differences and the specificities of the human brain, neuroeducation can help to effectively identify and address the challenges and needs of students with different abilities and learning styles. This can help create a more inclusive learning environment and ensure that all students have opportunities for success. Neuroeducation is based on the study of the connections between the brain and the learning process, allowing educators to adapt their teaching methodologies to the individual needs of students. This approach considers the cognitive, emotional and social differences of individual learners and offers customised educational tools to maximise their potential. Thus, the importance of neuroeducation training in schools to promote educational equity is crucial to ensure that every student has the same opportunities for learning and success.

Educational equity means equal access to educational resources and opportunities, regardless of socio-economic, cultural or geographical origin. Thanks to neuroeducation, teachers can identify and understand the different abilities and needs of students, ensuring that each student receives an education tailored to his or her characteristics. This makes it possible to overcome the barriers that often stand between students and quality education. Neuroeducation considers the biological and cognitive aspects of individual learning, helping teachers to identify students' areas of strength and weakness. In this way, they can develop targeted teaching strategies to address the specific difficulties of each pupil, fostering their inclusion within the classroom.

Through an in-depth understanding of how the brain works, teachers can create stimulating learning environments and adapt their teaching methods to the needs of each student. Neuroeducation promotes educational equity through the use of innovative teaching tools based on the latest discoveries in neuroscience. For example, experience-based learning allows students to connect the information

they learn with their personal experiences, making learning more meaningful and effective. In addition, the use of technological tools such as computers and tablets can provide students with access to a wide range of educational resources, enabling them to learn in an autonomous and personalised way.

Neuroeducation also promotes educational equity by providing targeted support to students with disabilities, learning disorders or other special needs. In recent years, neuroscience has made an important contribution to the evolution of certain pathologies. In particular, great strides have been made in understanding the neurophysiological basis, and the behavioural and cognitive developments underlying autism spectrum disorder (ASD) (Anagnostou & Taylor, 2011). Neuroscientific knowledge becomes more valuable when it is applied in the school environment to improve the cultural and social process and increase the state of individual well-being, not only of able-bodied children but also in children with disabilities. Advances in neuroimaging have had a significant impact on the quality of education provided to people with ASD and consequently on their social functioning. The advancement of research methodologies and technologies in the field of neuroimaging is becoming more and more indispensable as the detection of changes within milliseconds contributes to the early identification of factors influencing behaviour, improving the efficiency with which fundamental problems of individuals can be addressed. Teachers can use neuroscience-based teaching strategies to help these students overcome their difficulties and maximise their potential. This may include the use of multisensory teaching methodologies, the introduction of frequent breaks during learning or the use of support tools such as summary sheets and graphic organisers (Liparoti & Lopez, 2021). Neuroeducation is a fundamental approach in schools to promote the inclusion of people with disabilities. This approach is based on the integration of knowledge from neuroscience and education in order to understand the cognitive processes and individual needs of learners. The main objective of neuroeducation is to promote personalised teaching practices and strategies that take into account individual differences and the specific needs of students with disabilities.

One of the main benefits of neuroeducation is the possibility to detect and address possible cognitive difficulties early on, thus facilitating early and targeted intervention (Liparoti, 2022a). This allows school activities to be adapted to the different abilities of students, offering them the learning opportunities that best suit their needs. Furthermore, through the use of neurocognitive assessment tools, it is possible to accurately monitor students' progress over time, identifying any changes and adapting teaching strategies accordingly.

Neuroeducation also helps to break down cognitive barriers that may hinder the inclusion of people with disabilities. Through a better understanding of cognitive processes, teachers can adopt more flexible and customised teaching approaches that are adapted to the specific needs of individual learners. This means that students with disabilities are no longer seen as 'problematic' or 'less able', but as individuals with unique potential and talents that need to be enhanced.

Another important component of neuroeducation is the implementation of assistive technologies (Minino & Liparoti, 2023). These technologies offer tools and resources that enable learners with disabilities to actively participate in the teaching-learning process. For example, students with visual impairments can benefit from screen readers or speech recognition programmes, while students with motor disabilities can use alternative input devices, such as special keyboards or joysticks. These technologies enable students with disabilities to overcome their physical or cognitive limitations and achieve their learning goals.

In addition, neuroeducation aims to raise awareness among all those involved in the educational process, including teachers, parents and classmates. The aim is to promote the full inclusion of learners with disabilities and to create a welcoming learning environment where everyone feels valued and respected. Through the dissemination of knowledge and good practices on inclusion, neuroeducation aims to create a culture of diversity that fosters the full development of each individual's potential.

Finally, it is important to emphasise that inclusion not only concerns students with disabilities, but also the entire school community. Through neuroeducation, a greater awareness of the different learning modes and specific needs of each individual is promoted. This enables teachers to adopt inclusive teaching approaches that benefit not only students with disabilities, but also students without disabilities. In fact, inclusion is not only about removing barriers, but also about valuing differences and accepting each individual in his or her uniqueness.

Conclusions

In conclusion, training in neuroeducation plays a fundamental role in the contemporary educational context. Neuroeducation provides a sound scientific basis for making informed decisions regarding teaching strategies and can act as an effective agent of change in the student learning process. Its targeted application can improve learning effectiveness, promote emotional well-being and reduce educational inequalities, thus contributing to building a more equitable and

inclusive society. Neuroeducation offers innovative options to improve learning and teaching. Thanks to its principles based on an understanding of how the brain works, it can facilitate significant change in the school context. By implementing pedagogical strategies based on neuroscience and promoting a positive learning climate, neuroeducation contributes to creating an environment in which students can reach their full potential. The relationship between the concepts of neuroeducation and metacognition is crucial for promoting effective learning and autonomy in the learning process.

Training in neuroeducation is an effective agent of change in the school environment, providing teachers with the knowledge and skills needed to understand how the human brain works and apply neuroeducational principles to the learning environment. This approach can improve student outcomes, promote motivating and equitable learning, and create a more inclusive learning environment. Investing in neuroeducation training can make a difference in students' lives and in the quality of education.

In addition, the importance of neuroeducation in schools to foster the inclusion of people with disabilities is indisputable. Through this approach, it is possible to identify and address cognitive difficulties early on, break down cognitive barriers, implement assistive technologies and promote a culture of inclusion. The ultimate goal is to create a welcoming learning environment in which all students can develop and learn satisfactorily, without any form of discrimination or exclusion.

Finally, the importance of neuroeducation in schools to promote educational equity cannot be underestimated. Neuroscience provides educators with a solid basis for personalising learning and ensuring that every student has access to quality education. Teachers' work based on neuroeducation makes it possible to identify the strengths and weaknesses of each pupil and to develop targeted teaching strategies. The aim is to create an inclusive, stimulating learning environment adapted to the individual needs of each student, with the goal of achieving educational equity for all.

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