



Unlocking the potential

MOVEMENT AND LEARNING

The cerebellar connection and the link between physical education and learning

Introduction

For years, it appeared that the established educational and scientific communities believed that thinking and movement were totally separate and unconnected functions. During this time however, and without public support, maverick scientists were considering a possible link, which is now becoming widely accepted as a key-contributing factor in learning difficulties, namely cerebellum dysfunction and reparation.

The Cerebellum

The cerebellum is a highly complex part of the brain, which for many years was predominantly only considered essential to the control of movement, yet considering it is only one tenth the overall brain in size, it contains over half of all brain's neurons and more than 40 million nerve fibres.

A few decades ago, two US researchers, Henrietta and Alan Leiner, studied the cerebellum and noted that these millions of fibres not only fed information about movement and motor function, but also conveyed other cognitive (thinking) information as well and is intrinsically linked with learning. Their discoveries, combined with other supporting research from separate studies, dispelled the belief that the sole function of these fibre connections was motor function.

What is interesting to note is that the part of the cerebellum called the Dentate Nucleus is the last place in the cerebellum where information is processed before it is sent onto the cortex ('thinking brain'). This area is missing in most primates except for those with the highest learning capabilities. A smaller area of this nucleus, known as the Neodentate, which is only present in humans, may have a significant role in thinking.

Through his research Peter Strick* has traced pathways from the cerebellum to parts of the brain involved in memory, attention, language, emotion, decision making and spatial perception. Thus, the deduction from all of these discoveries, is that the cerebellum, the part of the brain which processes movement, also has a function in processing learning, possibly by filtering and integrating floods of incoming data and transferring that information to the thinking brain.

The importance of movement to learning – the vestibular cerebellar connection

So just how important is movement to learning? The vestibular (balance) system is the first sensory system to mature. In this system, the inner ear's semicircular canals and vestibular nuclei (its connections to the part of the brain called brainstem), is an information-gathering and feedback source for movements. These messages are sent to the cerebellum that also receives visual and auditory information from the eyes and ears. All of these electrical messages are relayed back and forth between the cerebellum and the thinking brain (cortex).

The cerebellum is also connected to a very important area called Reticular Activating Centre that is critical to our attention and sleep-wake cycle. The interaction between all these areas helps us keep our balance, turn thinking in to actions, coordinates our movements and keeps us alert and focused. That's why there is value in playground games that stimulate inner ear motion like swinging, rolling and jumping.

Motor development and learning

Illustrating the link further, a study undertaken in the late 1970s, showed that if one's movements are impaired, the cerebellum and its connection are compromised. Perhaps more importantly though, research studies have been showing that by using physical education and physical therapy on people (both with and without dysfunctional cerebellum), vast improvements can be made to their learning. Due to this, over the years many teachers have been integrating productive 'play' in to the curriculum in an effort to boost the cognition of their students.

Physical education and learning

Exercise has been proven to strengthen parts of the brain, including the cerebellum. Researchers have found that children who engage daily in exercise show superior motor fitness, academic performance and attitude towards school than those who don't. In a similar study, adults who regularly exercised demonstrated quicker reactions thought better and remembered more.

* Peter Strick, Ph.D., is a Professor within the departments of Neurobiology and Psychiatry at the University of Pittsburgh. Additionally, he serves as the Co-Director at the Center for the Neural Basis of Cognition (CNBC)

The movement arts

Students participating in art and dance classes have proven to gain immense benefits from doing so. Art has been linked to better visual thinking, problem solving language and creativity, whilst dance has been linked to physical balance and motor coordination.

Practical suggestions

Today's brain, mind and body research establishes links between movement and learning and as such, educators should be proactive in integrating movement activities in to everyday learning.