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Review Paper

Enhancement of Teachers' Knowledge through Neuroscience Constituents for Student -Teaching and Learning: A Systematic Review

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ABSTRACT

As an emerging and developing field in education, educational neuroscience has much to offer in terms of preparing and promoting teachers, and this article aims to provide in Enhancing the Teachers' Knowledge through Neuroscience Constituents to benefit Student -Teaching and Learning. Sixty-five pieces of literature from 1962 to 2022 in the fields 'abstract', 'topic' and 'title' have been integrated. Articles were reviewed and synthesised by using the content analysis technique under two overarching themes: First, Neuroeducation informs student teaching and learning, and Second Fundamental Structure and Functions of the Brain. Based on the findings, It was also clear that the content knowledge of Neuroscience holds strong conceptual positioning that might strengthen the Teacher's knowledge, Student -Teaching and Learning process. However, reaching a consensus about the inculcation of discipline in teacher education programmes is not possible in the short span. Therefore, article made a small attempt to bridge the gap.

Keywords: *Teacher's knowledge, Student -Teaching, Teacher Learning*

Teaching neuroscience integrates neuroscience, psychology, and education to improve teaching and learning. Since education aids learning, this shared interest suggests that science could replace schooling. Good instructors can use this material intelligently for rich, diverse, and difficult learners as part of their background knowledge. Trainee teachers learn about brain function without official training, which may harm their teaching. The NEP 2020 advocates teacher education programmes should collaborate with faculty in the field of Neuroscience and other disciplines, Further, by 2030, NEP aims that all standalone TEIs will be mandated to become multidisciplinary institutions. Neuroscience is an emerging and evolving discipline in education where its understanding must add to the corpus of the Educators' knowledge bank. To strengthen the multidisciplinary education of teacher education and provide rigour in conceptual development, The integration of neuroscience information aligned with the education discipline may provide additional knowledge to promote educators' better understanding of their students, helping to

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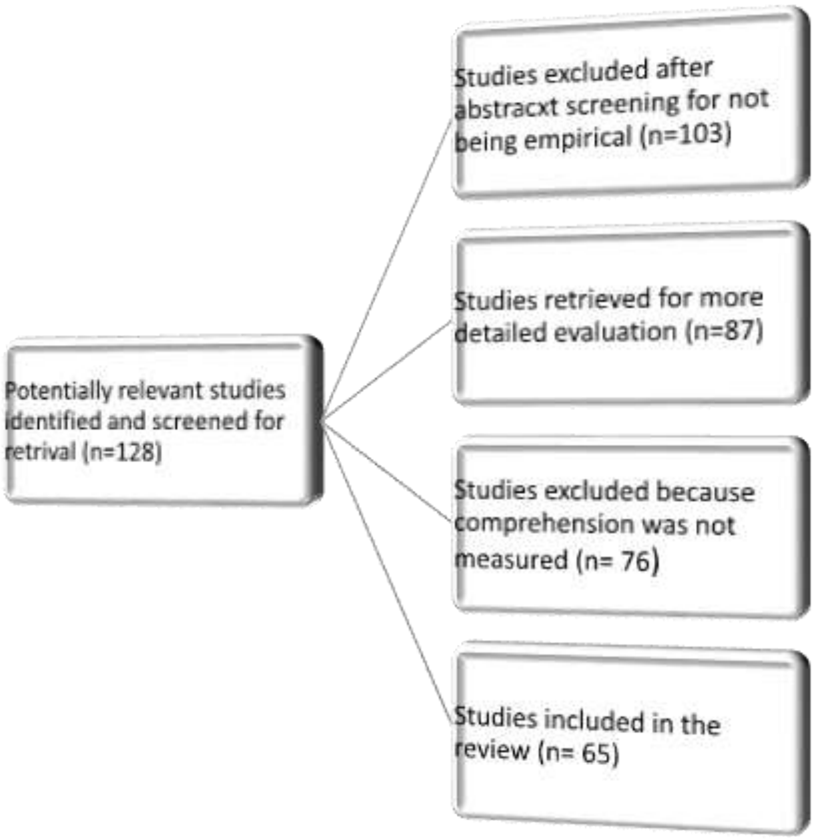
strengthen the multidisciplinary nature of teacher education. However, in such a short time frame, it is impossible to achieve consensus on the subject of changing disciplinary norms. There has been a lot of study done on the subject. As a result, the article made some limited attempts to fill the void.

Objective of the study

The main objective of this review paper was the Enhancement of Teachers' Knowledge through Neuroscience Constituents for Student -Teaching and Learning

METHODS



Initially, there were 128 potentially relevant studies identified and screened for retrival published peer-reviewed articles identified from 1962 to 2022 from Google Scholar, Elsevier, Eric, Sage, Wiley, Frontiers in Psychology, Oxford Review of Education, Oxford university press, Cambridge University Press, Asian studies review, Journal of child psychology and psychiatry allied disciplines, Journal of learning disabilities, Journal of Education and learning, and Nature review neuroscience databases using keywords such as neuroscience and education, Mind Brain and Education, Neuroeducation, Brain-based Learning and Brain-based Teaching. 25 Studies excluded after abstract screening for not being empirical Further, 16 studies retrieved for more detailed evaluation also 11 studies excluded because comprehension was not measured. Finally, studies included in the review (n= 65) were selected based on the existing evidence pertinent to a formulated objective, which uses pre-specified and standardized methods to identify and critically appraise relevant research, and to collect, report, and analyse data. Typically, it focuses on a very specific question, often posed in a cause- and effect form, such as "To what extent does A contribute to B?" therefore the information collected and systematized according to the two pertinent descriptors 1. Fundamental Structure and Functions of the Brain. 2. Neuroeducation informs student teaching and learning. Results were then analysed to determine what scientific theories and review papers had been published about the construct.

Characterization Data
Both components incorporate characterization data (publications per year), areas of application (Student teaching and learning) and fields of multidisciplinary research (Neuroscience, Psychology & Education), and various theoretical domains of knowledge.

Quality Appraisal
In accordance with the goals of the research, we conducted a systematic literature review of scholarly articles that provided in-depth discussions of how neuroeducation can have positive informs on both student teaching and learning and the fundamental structure and functions of the brain. construct validated by Neuroscience-based ideas.

RESULT & DISCUSSION

Theme #1 Neuroeducation Informs Student Teaching and Learning
The theme deals with the concepts of Plasticity, Neurogenesis, Emotion and Stress, The Role of Attention in Learning, Executive Function, Mind-Body Links, Anatomy, Imaging, Results, Mindfulness, Validation, Enrolment, Arts and Learning, Additional Benefits for Special-Needs Learners, Practical Suggestions, Support for Recess, Play, and Physical Education.

Plasticity
The capacity of the brain to change its own physiological structure over time is referred to as plasticity. Each new experience contributes to the formation of new connections between groups of neurons in the brain. It is wonderful news for instructional leaders and teachers who have the goal of continually developing their knowledge and skills.

Neurogenesis
The process through which neurons are created inside the nervous system is called neurogenesis. This process involves the production of highly specialised neurons within the brain, and it occurs during both foetal and adult development (Hannah Simmons, n.d.). Individual cells that are found in the brain and the nervous system are called neurons. Neurons are responsible for controlling how information is stored and processed in the brain, spinal cord, and nerves. Stem cells can also take the shape of neurons, which differ from other cell types in their inability to send outgoing electrical signals and their many dendrites, which are responsible for sending encoded information throughout the nervous system.

Emotion and Stress
Emotions have a significant impact on a variety of cognitive functions within the human brain, including perception, attention, learning, memory, reasoning, and problem-solving. Studies have shown that motivational behaviours, including emotions, can either improve or hinder learning as well as long-term memory and learning. "Attention and control of execution is fundamentally limited, and it is directly tied to the learning capacities that are more effectively focused on pertinent information". The advent of neuroimaging has allowed us to gain a deeper knowledge of the ways in which emotional states influence the processes of learning and memory. Teachers are increasingly being asked to engage in

volunteer management of children who are under a great deal of stress at school. Recognizing the various stress responses of pupils to teachers is now an essential stage in the process of catering for the specific requirements of children while they are enrolled in school.

The Role of Attention in Learning

Psychology was the field that pioneered the study of attention as a scientific phenomenon. There, cautious behavioural tests can yield accurate representations of a subject's attentional inclinations and talents in a variety of settings (Tyng et al., 2017). The primary goal of cognitive psychology is to translate these data into models of mental processes that are capable of producing such observable patterns of behaviour. With the development of non-invasive methods for monitoring human brain activity like as electroencephalography (EEG), functional magnetic resonance imaging (fMRI), and magnetoencephalography (MEG), the influence of single-cell neurophysiology in non-human primates has become more direct. (Lindsay, 2020). There have been a great deal of word models and computational models developed, each of which postulates a different set of underlying mechanisms (Borji & Itti, 2013; Driver, 2001). It is feasible to observe the neurological activities that are taking place in the background. As a result of this, computational models of brain circuits have been developed, and they are now capable of recreating certain aspects of the neuronal responses that are associated with attention (Lindsay, 2020; Shipp, 2004)

Executive Function

Executive function directed by the PFC (prefrontal cortex) network responds to inputs with the highest level of cognition. "Cognitive processing of information takes place in the area of the prefrontal cortex",(TeachThought Staff, 2013) which consciously controls emotions and thoughts. The prefrontal cortex (PFC) is a pivot of a neural network with inputs and outputs to all other brain areas(TeachThought Staff, 2013). This control uses structured information to organise, analyse, sort, connect, plan, prioritise, order, self-monitor, self-correct, evaluate, summarise, problem-solve, and focus attention, and links to appropriate actions are possible(Willis, 2013). In addition, the PFC relational can mentally manipulate working memories to become long-term memory and can consciously evaluate emotions. These functions include information evaluation, prediction, conscious decision making, emotional awareness, and response, organising, analysing, sorting, connecting, planning, prioritising, sequencing, self-monitoring, self-correcting, assessment, abstraction, deduction, induction, problem-solving, attention focusing, and linking information to planning and directing actions (TeachThought Staff, 2013).

The Importance of Movement and Learning

"Sit and git" is still the dominant model for formal learning. Why do we persist when teachings are not enough (Dolcourt, 2000; Slavin, 1994)? Brain research can reveal how the body and mind interact. Movement and learning are linked, thus evidence should support the claim(Eric Jensen, 2005).

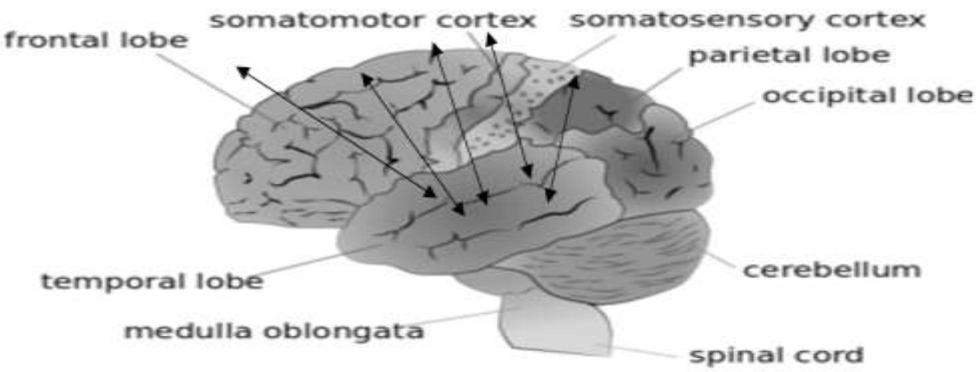
Mind-Body Links

The initial evidence of a mind-body connection comes from numerous proposals during the previous century (Schmahmann & Sherman, 1997). Neuroscientists now agrees that movement and cognition are closely intertwined.

Anatomy

The cerebellum controls movement. It is the size of a fist and located below the occipital lobe. The cerebellum contains roughly half of all neurons although taking up only 10% of the brain. This dense neuronal structure may be the brain's most complicated. It has 40 million nerve fibres, 40 times the complex optic nerve system. These fibres send and receive signals from the cortex and cerebellum. Most cerebellar neural pathways are "extroverted" and impact the brain. Peter Strick of Syracuse Veterans Medical Center found another link. His colleagues traced the cerebellum-brain circuits for memory, attention, and spatial cognition. Learning and movement occur in the same brain region (see Figure I).

Figure I Cerebellum and other parts of brain licensed under CC BY SA-NC



Imaging Results

New findings, particularly from fMRI research, corroborated the similarity of cognitive and motor regions like the cerebellum. We learn to ponder before moving. (2003). This shows that all motor action starts with a brief cognitive process that sets goals, analyses factors, anticipates consequences, and performs motions. This requires widespread sensory connection. A study of supporting links between exercise and visual, language, memory, and attention systems (Courchesne & Allen, 1997). (Shulman et al., 1997), (Kim, Ugirbil and Strick, 1994) (Desmond, Gabrielli, Wagner, Ginier and Glover, 1997) These studies show no function movement. They interact with the cerebellum in mental processes like prediction, ordering, timing, practise, and task rehearsals(Eric Jensen, 2005). The cerebellum predicts and corrects large motor task sequences and mentally practised activities. Complex tasks increase student cerebellar activation (Ivry, 1997). Evidence strongly links motor and cognitive functions.

Mindfulness

Is movement crucial to learning? The vestibule and cerebellum mature initially. Movement feedback comes through the inner ear's semicircular canals and vestibules. Nerve connections connect the cerebellum to the visual system and sensory cortex(Eric Jensen, 2005). The vestibular nucleus and reticular activating system are controlled by the cerebellum. The attention system needs this area to control sensory input. This interaction balances, coordinates, and acts on thoughts. Rocking, rolling, and leaping on the playground are beneficial. A routine can include spinning, sliding, scrolling, shaking, rocking, and pointing.

Validation

Most of the 33,000 scholarly publications on exercise in MEDLINE support its benefits. Exercisers exhibited significantly more cerebral mass than non-exercisers (Anderson, Eckburg, & Relucio, 2002). Simple biology links movement with learning. Blood flow promotes brain oxygen, which is necessary for brain function. Physical activity reliably increases blood flow and brain oxygenation. William Greenough of the University of Illinois found that mice that exercised in a rich environment had more neuronal connections(Eric Jensen, 2005). They have more brain neuron capillaries than sedentary mice (Greenough & Anderson, 1991). Even brisk walks might cause this arousal. Heart rate, EEG activity, and excitatory brain chemicals increase(TeachThought Staff, 2013). If you haven't rested yet, stretch. Why? Standing increases heart rate and blood flow by 5-8 per cent in seconds. In animal research, spontaneous exercise changes gene expression to improve learning and memory. (Tong et al., 2001). This gene expression pattern enhances several neuron coding and transmission, synaptic shape, activity, and plasticity variables. These processes aid learning.

Enrollment

Why worry? Exercise strengthens the basal ganglia, cerebellum, and brain beams, as well as muscles, heart, lungs, and bones—all vital brain regions. Exercise delivers brain oxygen and neurotrophins (nutrient-rich chemical "packages" that increase the number of connections between neurons) (Eric Jensen, 2005). Exercise increases brain cell growth in neuronal mice, which is surprising (Van Praag et al., 1999). Neurogenesis also improves cognition, memory, and depression risk (Kempermann, 2002). Exercise boosts brainpower! Students who don't exercise have many possibilities and responsibilities. Only approximately a third of kindergarten through high school pupils attend daily physical education lessons.

Arts and Learning

The integration of the arts describes as facilitating the effective transfer of knowledge and skills from the arts to the non-arts realm. Art forms are taught, such as dance, play, visual arts, and music, in individual classes focused on acquiring art standards. At the same time, art-based activities teach other disciplines and concepts in content other than the arts.

Additional Benefits for Special-Needs Learners

Teachers have found that programs that include exercise help special-needs learners. People in the intervention group showed significantly more improvements in agility, reading and language fluency than the control group. Some routines that require slow movements can do the opposite and promote a state of focus by soothing hyperactive students.

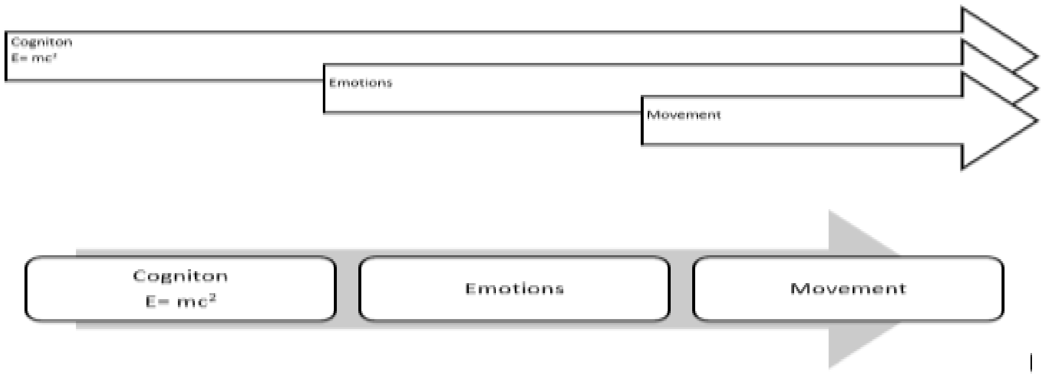
Practical Suggestions

Brain-friendly learning means that teachers must combine math, geography, social skills, role-playing, science and physical education, athletics, drama, and the arts. Energiser activities can raise blood pressure and epinephrine levels among drowsy learners, reduce restlessness among anxious learners, and reinforce content. Play tug-of-war, rewrite lyrics in a familiar song, or solve puzzles as a team with poster-sized mind maps. Cross-arm and leg activities allow the cerebral hemispheres to better "talk" to each other. Thirty minutes a day, 3-5 days a week is sufficient exercise for many students. Rest includes brisk walking, running, or high-energy play. Short breaks can excite students and make them "overfocused". Longer rest periods use more energy but are not sustainable. This model allows students to focus more on the task at hand.

Support for Recess, Play, and Physical Education

Many play-oriented movements can improve cognition, including the following: Aerobics, running, chasing, dance routines, rough and tumble sports and physical exercise. Exercise can increase catecholamines (brain chemicals such as norepinephrine and dopamine) responsible for energy and mood. Exercise is crucial for the development of the brain for reasons beyond purely academic interest. It improves the body's resilience to stress by "training" it to recover more quickly from rapid adrenaline surges. Catecholamines are responsible for energy and mood, and exercise can increase their production. Educators need to understand that what their pupils are going through is nothing more than a normal, healthy blending of body and mind (see Figure II).

Figure II Understanding the old and new relationship between mind and body



Source: (Eric Jensen, 2005) *Figure II*

Students' brains adapt to their schools, homes, workplaces, and communities. Learning changes neuronal connections in specific brain locations via electrical and chemical signals. Academics must provide a high-quality alternative to commercial and specialised "brain" research applications. People should expect that from teachers and schools. Neuroscience has improved our understanding of learning's biological aspects, but can it help instructors with curriculum? Education's biggest ethical transgressions have gone unaddressed. Cranial neuroethics and a new discipline of neuroeducation can enhance everyone's understanding of effective schools. Dyslexic youngsters who undergo educational treatments have brain activation patterns similar to those without reading difficulties. Goswami uses neuroimaging to assess educational programmes like the Dre programme, which uses balancing exercises to promote reading. These findings may help instructors recognise that even if children with dyslexia improve behaviorally, they may receive written material differently.

Theme #2 Fundamental Structure and Functions of the Brain

The theme deals with the concepts of Brain Structures and their function associated with the teaching-learning process namely Cerebrum, Brainstem, Brain hemispheres, Cortex, Lobes of the brain i.e., Frontal Lobe Temporal Lobe, Optical Lobes, Motor Strip, Somatosensory Strip, Cellular Brain, Language, Deep structures and functions of the brain, Hippocampus, Gray Matter, Affective filter, Positron Emission Tomography (PET scans), functional Magnetic Resonance Imaging (fMRI), and Memory.

Brain Structures

The brain combines the cerebrum, cerebellum, and brainstem(Mayfield Brain & Spine, n.d.)

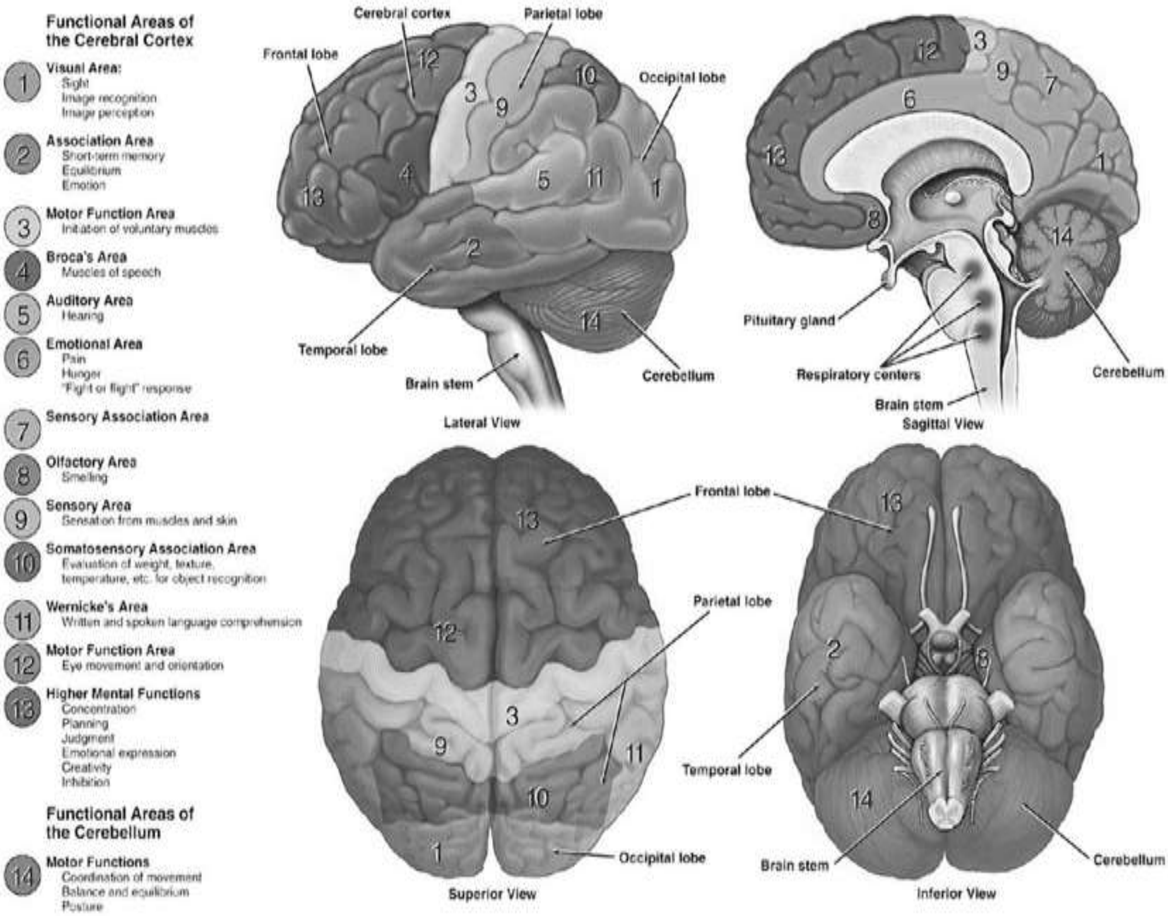
Cerebrum

The cerebrum is the most vital part of the brain and is composed of the right and left hemispheres(Facts, n.d.). Perform advanced functions including touch, vision, auditory interpretation, speech, reasoning, emotion, learning, and fine-tuning of movement(Carole Sakar, n.d.).

Cerebellum

The cerebellum is a big, cauliflower-shaped organ located at the base of the brainstem, behind the cerebral cortex. Learning to move quickly, remembering past experiences, and using one's vestibular system all rely on this structure. Striated tissue, which in the cerebellum looks like muscles rather than folds and wrinkles, is seen there (Hart, 1983). It contains more neurons than any other region of the brain and helps us maintain our equilibrium and mobility while also influencing our ability to learn and remember information in a wide variety of contexts. Massive volumes of data are sent to the cerebellum, which is why its classification and processing abilities from the cortex are both essential and amazing (Many People Do Not Necessarily Use Both, n.d.). It is possible that the importance of studying the cerebellum, which has been found to have a larger role in cognition than was previously thought, is the impetus for a closer look at PE and other school activities. Posture, balance, movement, coordination, and even a measure of self-awareness are all under its purview (Facts, n.d.).

Figure III Fundamental Structure and Functions of the Brain Licensed Under CC BY-SA



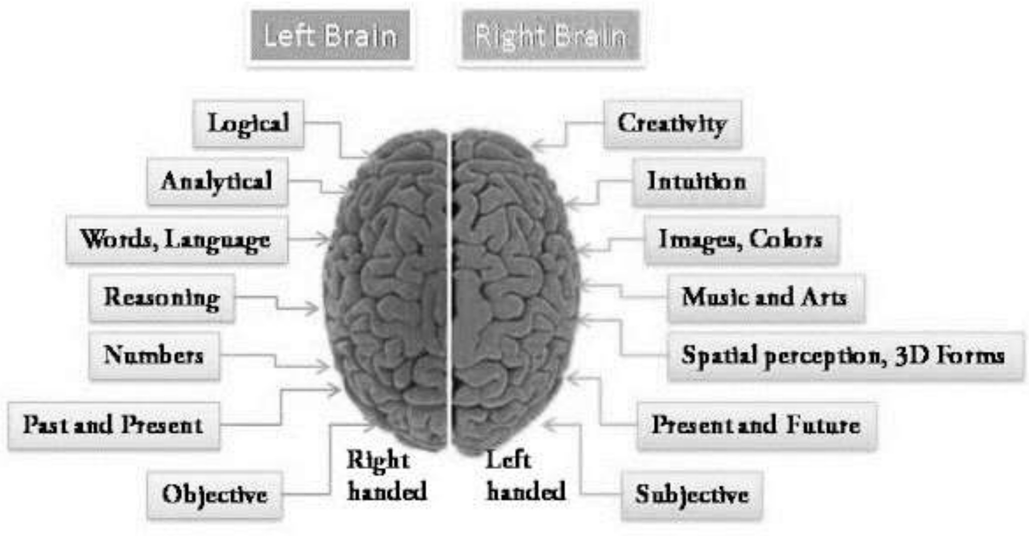
Brainstem

The brainstem is a relay station for signals travelling from the brain and spinal cord (OGAWA, 1962). Numerous physiological processes, such as breathing, heart rate, body temperature, waking and sleeping, digestion, sneezing, coughing, vomiting, swallowing, etc., are carried out automatically by the body. In addition, the brain stem is essential for life-sustaining processes including maintaining a regular heartbeat, breathing, and blood pressure, as well as for controlling reflexes like swallowing and determining one's state of consciousness and hormone levels (Rams, 2011).

Brain hemispheres (Right brain – left brain)

Human brains, which look like grapefruits, weigh 3 pounds and have two hemispheres (Many People Do Not Necessarily Use Both, n.d.). Living brains are like toothpaste inside the skull. Though fresh from the tube, it doesn't stick like toothpaste. Making a fist with both hands and bringing the palms together resembles the brain. Like hands, each brain hemisphere includes two identical components (two index fingers, two palms, etc.). Each form has a near-identical sister in its hemisphere. Right hemisphere controls left side, vice versa. Despite their similarities, these hemispheres work differently (Hart, 1983). Each brain hemisphere is extremely specialised, which optimises a wide range of perceptions and sensing systems. The right hemisphere excels at spatial awareness and wordless tasks. It increases one's ability to think and reason, engage with others, take the whole picture into consideration, assess, understand and use dialects, retain visual information, and more. The left hemisphere excels at writing, speaking, calculating, analysing, grammatical correctness, literal meaning, and linear thinking (Many People Do Not Necessarily Use Both, n.d.). The corpus callosum joins the brain's left and right hemispheres despite the skull's vast fissure (Many People Do Not Necessarily Use Both, n.d.). Axons in the corpus callosum carry neuron messages to other brain cells. Like some legs, the brain beam connects the left and right sides of the body (Hart, 1983).

Figure IV Left and Right Hemisphere of the Brain is Licensed Under CC BY

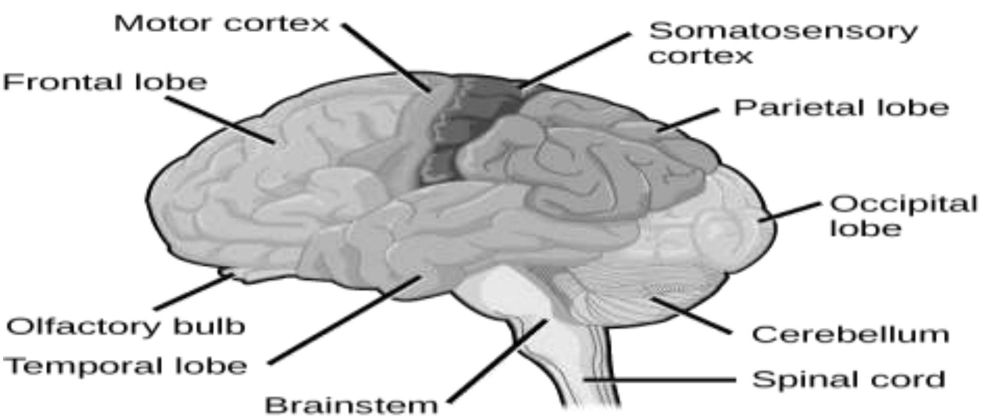


It's dated to talk about somebody having a "right brain" or a "left brain," but the fact remains that the two hemispheres of the brain have different areas of expertise. This concept has the potential to serve as a helpful alert for educators. That is to say, the students in the classroom all bring unique perspectives and expertise to the table. Though the need for a linear and continuous (left hemisphere) map typically surpasses others, some pupils are able to see the big picture (right hemisphere) before getting too bogged down in the details. Right brain activities include visual and spatial processing, as well as other non-verbal abilities, while left brain activities include speech and language (Waugh et al., 2018).

Cortex

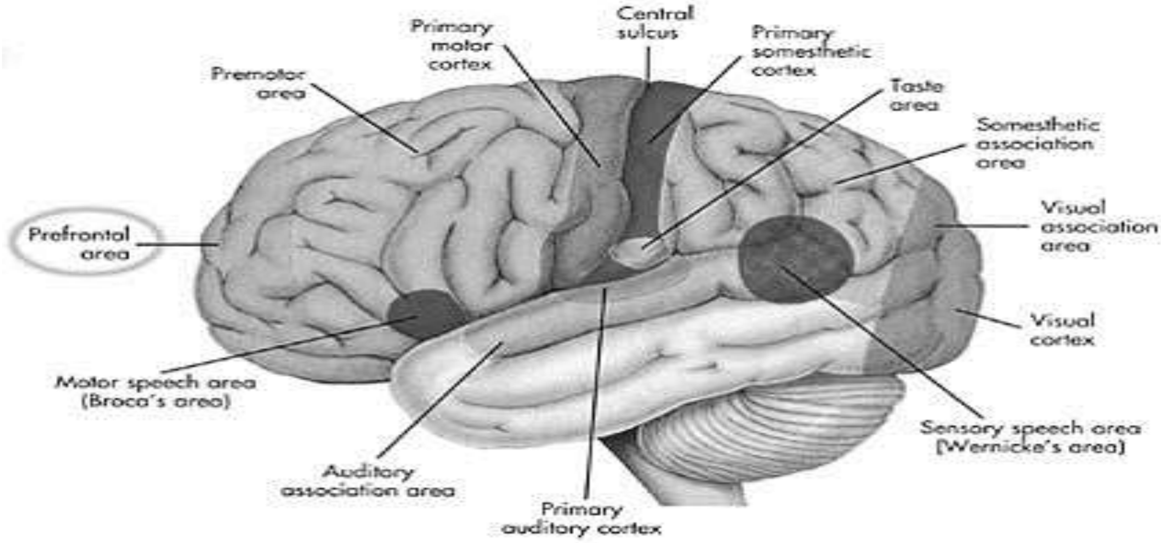
A blanket that is only half a circle appears like it has been crumpled. The bark is the outer layer, and the folds and ridges within it are called grooves and ridges. Neurons, a type of brain cell, populate the cerebral cortex's six distinct layers. The cortical appearance is grey because of these neurons, which are also called grey matter (Many People Do Not Necessarily Use Both, n.d.).

Figure V Cortex and Brain is Licensed Under CC BY-SA



In order to expose more of the cortex once it has been smoothed away, the cortex takes on a wrinkled appearance. Comparable in appearance to a huge pizza in size. Because our minds develop and expand as we acquire new knowledge, this wiggle room is essential (Hart, 1983). Many people will be surprised to hear this, and it could change a student's mind about whether or not they think knowledge is static.

Figure VI Lobes of Brain is Licensed Under CC BY-NC



When viewing an image of the human brain, you may notice that some areas are more sharply divided than others. Each of the lobes of the brain has a specific purpose, from thought and movement to semantic processing and memory retrieval (Many People Do Not Necessarily Use Both, n.d.). When jogging around the track, one's brain may be using a distinct set of neural circuits than when tackling an algebra problem. This is not to say that only particular parts of the brain are active at any given time; rather, numerous brain regions collaborate to achieve a common goal. When we think about something, we actually use a virtual constellation of pathways, with contributions from many different parts of the brain (Hart, 1983). The four major lobes of the brain are the frontal, temporal, parietal, and ocular lobes, respectively. Between the parietal and frontal lobes lie the motor and somatosensory strips. By learning how the various lobes work, we may better appreciate the value of inputs that incorporate a variety of forms. It can occupy separate regions of the brain, opening new neural connections (Hart, 1983)

Frontal Lobe

Frontal lobes are behind the forehead and simple to spot. These two lobes contain the executive-functioning prefrontal cortex and make up around one-third of the cortex. The frontal lobe helps us create objectives, defer gratification, recognise future consequences of current actions, ignore or repress incorrect responses, recall non-task-based memories, synthesise information, and interpret emotions. Problem-solving, critical thinking, and creativity thrive in this brain region. The frontal lobe matures by 20. (Hart, 1983). Many K–12 pupils have underdeveloped brains. Pre-schoolers and high schoolers use their frontal lobes for higher-level thinking. However, our students may not always have executive thinking like adults. How can schools replace a child's frontal lobe? Goal setting helps kids defer pleasure by using the classroom's upfront function as a springboard for prefrontal activity. The bangs eve also helps, engages, and guides frontal lobe use by adopting a classroom routine in which kids listen to their classmates without interruption or in shifts (Hart, 1983). Educators must safeguard the frontal lobe, which is essential for learning, memory, and high-level thinking, from physical or psychological harm. Do. These lobes control executive function: decisions, planning, attention, behaviour, emotion, speech and language, memory, and planned movement.

Parietal Lobe

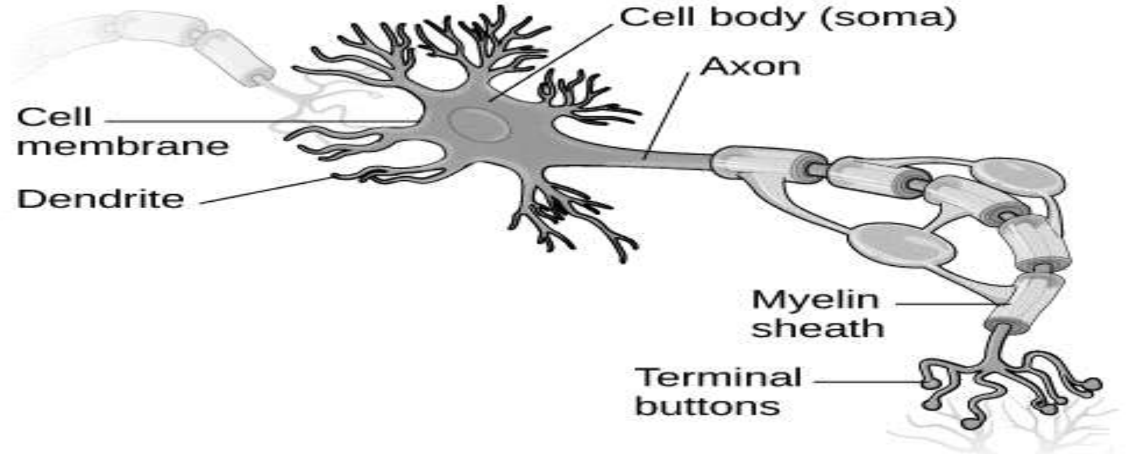
The parietal lobes are behind the frontal and in front of the optical. Parietal leaves aid sensory integration. The parietal region processes visual-spatial "place" and "method" streams. They help us locate ourselves in space and move our bodies and objects. This lets users navigate a crowded area without bumping into others or knowing how far to walk to the coffee shop in front of them. A student who lacks orientation and integration knowledge about where their body is in space may appear clumsy or not "with him" in class. However, a teacher who understands a brain structure related to this ability may be able to aid students with balance or estimating by adopting tactics that incorporate such skills, such physically practising routines and procedures. The brain's processing centres handle perception, making meaning of things, and sensation—touch, pain, hot, and cold.

Motor Strip

Feelings of pain, heat, and touch are all processed in the brain's motor cortex. Whether it's for perfecting one's fastball or mastering the double backflip, a coach can be invaluable. The best strategy to help pupils learn motor skills is to provide them plenty of opportunities to practise those skills. Sound and language processing occur in the brain's temporal lobes.

They are also a part of the system that regulates memory. Receptive language processing takes place in the left lobe, while musical perception takes place in the right. They help you pick up on nuances in tone of voice, rhyme, and prosody.

Figure VII Gilia Cell and Associated Parts of The Brain is Licensed Under CC BY



A neuron can be thought of as a miniaturised computer. Cell bodies, dendrites (branched protoplasmic extensions that sprout from the arms (axons) of neurons, and axons are the three main components of a neuron. Dendrites are responsible for the conduction of nerve impulses between neurons. In response to training, experience, and information storage, several dendrites can grow along a single neuron. Branches of new dendrites form from neurons that are often stimulated. Both the axon (which transmits information) and the dendrite (which receives it) grow in response to proteins known as neurotrophins. The human hand is a reasonably accurate representation of a neuron. The DNA resides in the cell body, which is symbolised by the palm. Dendrites are represented by the hands, whereas axons are the short, fibrous extensions that neurons use to communicate with other cells, such as other neurons, muscles, and sweat glands. Myelin is a fatty insulator and superconductor that wraps around the axon. Myelin is a fatty, waxy substance that ensures the brain functions at peak efficiency. Roughly 100 billion neurons make up the human brain. The brain acts as a processor, orchestrating cognition through the interplay of its many networks of neurons. Networks may function more effectively the more frequently they are used. To the extent that networks can be made to function effectively, there is a possibility that neural networks will grow in complexity and complexity. Learning is an active process that is partly under the control of the learner, and this information is useful for leaders, teachers, and students. It's possible that effort, practise, and ingenuity are more influential in developing one's potential than heredity. Teachers have some say in which activities, alterations, etc. They may alter their surroundings in order to improve the connection between neurons, which is essential for learning.

Language

The left hemisphere of the brain is the "dominant" hemisphere since it is responsible for language and communication. The right one, however, is crucial for understanding visual data and spatial relationships (Blease et al., 2001). However, approximately one-third of left-handed people may find that their right brain is responsible for speech. Therefore, specific tests may be required to determine whether the speech centre is on the left or right side of the brain in left-handed individuals prior to surgery. Aphasia is a language problem characterised by difficulty with all aspects of communication, including understanding, speaking, reading, and writing. The location of brain injury determines the specific kind of aphasia. The left frontal lobe is where you'll find Broca's field (Fig III). If this area is damaged, pronouncing can be difficult because it requires the use of the tongue and facial muscles. Broca's aphasia causes a person to have normal reading and listening comprehension abilities but severe difficulties with expressing themselves in written or spoken language. Location of Wernicke's area in the left temporal lobe (Fig III). Wernicke's aphasia is brought on by damage to this region. Some people have the ability to string together numerous words into meaningless phrases. They have the ability to produce vocalisations that resemble human speech. However, they have a hard time understanding others and do not pick up on errors in speech (OGAWA, 1962).

Deep structures and functions of the brain

The hypothalamus, which sits on the floor of the third ventricle, regulates the body's automatic processes. As well as controlling core physiological functions including core temperature, blood pressure, emotions, and hormone release, the hypothalamus also regulates basic behaviours like appetite, thirst, sleep, and sexual responses. The pituitary gland, also known as the principal gland that governs other endocrine glands in the body, is located in a small bony pouch at the base of the skull called the Sella turcica and is connected to the hypothalamus in the brain (OGAWA, 1962). Controls the maturation of sexual organs, stimulates the development of skeletal and muscular tissue, and responds to stress by secreting hormones. Melatonin, produced by the pineal gland located behind the third ventricle, plays a role in keeping the body on its regular sleep-wake cycle. The thalamus is a communication hub between the brain's sensory and motor cortices (Blease et al., 2001). It's involved in processes like paying attention, getting amped up, feeling pain, sensing the world, and remembering things. The caudate, putamen, and globus pallidus are three of the nuclei that make up the basal ganglia; together with the cerebellum, they control fine motor skills like moving the fingers (Quizlet, n.d.). The amygdala, the target cortex, the hippocampus, the septum, and the basal ganglia are all parts of the limbs, which are a network of brain structures responsible for activity and development. The amygdala is located in the limbic system's temporal lobe. The amygdala is the only brain region involved in the reaction at first. Radioactive glucose and oxygen were shown to work in the amygdala. Recent information from the sensory input areas of the brain may bypass the amygdala's efficient filters and access memory pathways when the amygdala is overactivated due to stress, fear, or anxiety (Willis, 2013).

Hippocampus

Important for memory formation are the grey matter ridges that run at the base of each lateral ventricle of the brain. The hippocampus takes in data from the senses, processes it, and links relevant details from new information to those already stored in long-term memory. Input from the senses into relational memory structures (Willis, 2013).

Gray Matter

In comparison to the white matter, which is primarily made up of supporting cells and connecting tracks, grey represents the brownish-grey colour of the neuronal cell bodies (neurons) of the brain's outer cortex. The outer layer of the brain, or cortex, appears darker grey because neurons are darker than other brain matter. This outer layer is referred to as grey matter (Richa Malaviya, 2018).

Affective filter

Emotional filters are stressful, emotional states in children that do not respond to the processing, learning, and storing of up-to-date information. This emotional filter is located in the amygdala and is hyperactive during periods of high stress. In this hyperstimulation state, up-to-date information does not pass through the amygdala to reach the higher thinking centres of the brain (Willis, 2013).

Positron Emission Tomography (PET scans)

Activation of brain regions raises the need for glucose and oxygen, prompting the injection of radioactive isotopes into the blood, where they bind to glucose molecules. Glucose-bound isotopes give off detectable emissions that can be used to create a spatial map of neural activity. A higher radioactive decay index indicates more radioactive decay in that region of the brain. Brain activity during the processing of sensory information is reflected in the PET scan's findings of increased blood flow, oxygen consumption, and glucose metabolism in active brain tissue. Because radioactive decay decays rapidly, PET scans can only be used for short-term operational monitoring (OGAWA, 1962). As a result, fMRI has surpassed other functional imaging methods as the method of choice for learning research since it does not impose this time limit.

functional Magnetic Resonance Imaging (fMRI)

Functional magnetic resonance imaging (fMRI) examines the brain's response to visual, auditory, or tactile stimuli to determine which brain regions are active during the relevant cognitive and performance tasks (Willis, 2013).

Memory

The three phases of memory—encoding, storing, and recalling—are intricately intertwined and are responsible for determining what information is most important to remember (Quizlet, n.d.) Various forms of memory are associated with distinct regions of the brain. But first, the brain must focus and repeat the process of coding, which is the transformation from working memory to long-term memory.

Working memory, often known as short-term memory, occurs in the prefrontal cortex. Data is held for roughly 1 minute, and there is a cap of about 7 items. To call the example number you just gave would be one example (Rams, 2011) It also plays a role in reading, helping you remember the previous sentence so that the one after it makes sense and can store or rearrange information for later use. Any material that can be held in short-term memory for up to a minute; the average adult brain (and less in children) can hold between seven and nine separate pieces of information. More information on using cognitive load theory in the classroom to teach about short-term and long-term memory can be found here (Willis, 2013). Meaningful connection and analysis of pre-existing patterns and prior information are the building blocks of long-term memory. The structure of the brain circuit is altered physically due to the reinforcement (Willis, 2013). The temporal hippocampus controls long-term memory, which is engaged when an individual has a need to remember information for a substantial period of time (Isn, 2012). Memory can store an infinite amount of information for an infinite amount of time (Galaburda, 1978). It stores not only data but also one's own personal recollections. The cerebellum's mechanism of storing knowledge about how to use that knowledge transmits that knowledge to the basal ganglia (OGAWA, 1962). Automatically acquired skills like shoe-tying, instrument-playing, bicycle riding, and so on are stored there.

CONCLUSION

Most of teachers don't know too much about our brains despite the fact that they are the most important organs in our bodies. As teachers and students, we may all benefit from a better understanding of the neural processes at work during learning. Using what we now know about the brain's anatomy and physiology, we are able to improve our learning process and acquire knowledge more rapidly, efficiently, and thoroughly. In order to determine which new row science–inspired student–teaching techniques are supported by empirical evidence and which facts about the brain reflect current consensus with neuroscience, researchers in the field of educational neuroscience have begun compiling a set of resources through meta–analysis and reviews. Over-generalization is common in the early stages of any new field of endeavour, but as this subfield of educational neuroscience becomes established as the norm, training standards rise and information flows in both directions, improving both research and practise. The results found that research in neurosciences can add more knowledge as a multidisciplinary discipline in enhancing teachers' knowledge about their students. This common ground suggests that the findings of educational neuroscience will have a profound impact on the future of education and training. Preparing educators is a multifaceted endeavour that calls for expert tutelage in the areas of practise, knowledge, attitude, and value formation. The integration of neuroscience information in field of Education provides insight into a new area of study that shall enrich a teacher's academic background. The field of neuroeducation is still relatively new to the field of teacher education, although it is becoming increasingly common in top-tier academic institutions.

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Conflict of Interest

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