Scholarly Research Journal for Humanity Science & English Language
Online ISSN 2348-3083, SJ IMPACT FACTOR 2024: 8.058
https://www.srjis.com/issues_data/230
PEER REVIEWED, REFEREED & INDEXED JOURNAL FEB-MAR 2024, Vol-12/62

IMPORTANCE OF NEUROSCIENCE OF LEARNING IN SHAPING COGNITIVE ATTITUDE OF TEACHERS TOWARDS INCLUSION IN EDUCATION

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Paper Received On: 12 March 2024

Peer Reviewed On: 28 March 2024

Published On: 01 April 2024

Abstract

India is the largest populated country in the world. As per the Census 2011 India NSSO, 2.21 percent (2, 68, 10,557) of the total population have some kind of disability, and out of the 2.9 million disabled population, 990,000 around 34 percent are out of school under the age of 14 years in India. It is gradually being accepted throughout the world that with the use of new advanced technology, supportive devices, and early diagnosis, we can accommodate developmental and accidental disability in settings of learning or acquiring new knowledge with other students of general schools. It has come to know that educating children with challenging learning needs in separate special education classrooms promotes the segregation of these children from society. Ultimately, these children have to live and enjoy their lives within their society with diversity. Hence it is the need of the hour to change the teaching-learning environment to an Inclusive learning environment where they learn to live together. Ample of studies are there shouted in one word that the negative attitude of general school teachers towards inclusion is a big challenge among all other challenges in the implementation of inclusive education. This present study seeks to bring the attention of curriculum framework experts of govt. or non-govt. institutions both on how the incorporation of an understanding of the neurophysiology of learning and other cognitive aspects of learning in teacher training programs at all levels will be helpful in changing the mindset of teachers in a favorable direction towards inclusive learning and the cognitive aspect of new knowledge will definitely help in changing the affective as well as the conative aspect of an attitude of teachers towards teaching in Inclusive classroom.

Key Words: Learning, Neurophysiology of Learning, Cognitive Attitude, Cognitive Inclusion

1. **Introduction:** Education is the powerful instrument in one's hand to unlock the doors of the darkness of the mind and fill it with the light of knowledge and wisdom. People without education get easily manipulated by ill-meaning leaders and beliefs. To live with one's self-respect and independently in society each one must be educated. Therefore, Education is considered a fundamental right to all that nourish our basic instincts and develop all aspects of our life. Even then, the education of children with disability in India is of higher concern. The disability population is higher in rural areas and education services are more facilitated in urban areas and about 34 percent of children with disability of school age is out of school. Hence to make quality education accessible and approachable to all including disability and to achieve the goal of education for all with the protection of the rights of children with disability India signed the world document on 'Universal rights for persons with disabilities' in 2007 (Ministry of social justice and empowerment, 2019). Villa and Thousand (2000) explain that quality of inclusion is not merely determined by the placement of students in schools it is actually determined by creating an environment that supports and includes all learners, Kunc in 1992 stated that "*...the fundamental principle of inclusive education is the valuing of the diversity within the human community*" (cited in Matheu & Alur, 2009). In the Indian context, inclusion can be seen in three perspectives Physical Inclusion (includes the accommodation of the school's physical environment, infrastructure, facilities, and educational policies), Social inclusion (promoting the full participation of this group of children and youth in all social activities as a part of society and move society towards an inclusive society), and Cognitive inclusion (Curricular and co-curricular adaptation, and use of diverse intellectual learning activity in one classroom).

On the basis of **reviews** of research papers and articles, common challenges in inclusion are challenges related to the infrastructure of teaching-learning institutions, attitudes of parents, children, and teachers, and adaptation of curriculum. A negative teacher's attitude is considered the most important to be encountered among all challenges. Attitude could be defined as one's direction of totality in behavior towards an object, event, task, or problem which could be positive, negative, or neutral. A person with a positive attitude is always ready to handle a situation in an effective manner with all its high levels of related efficacy.

1.1 **Attitudes and Cognitive Attitude:** Attitude is a complex construct in itself comprised of three dimensions Cognitive, affective, and conative attitude. Cognitive Attitude includes information, beliefs-disbeliefs, knowledge, ideas, and understanding of an object whereas the affective domain of attitude refers to the liking or disliking of an object resulting from its related knowledge understanding, and experiences and the third one is conative attitude refers to the actions towards an object highly correlated with the cognitive and affective domains of an attitude. In the same way, the positive outcome of working in a challenging situation affects cognitive and affective vice versa. Hence to bring change in the attitude of General School Teachers towards inclusion it is important to enhance the knowledge of teachers related to the basic physiology of learning. The purpose of this study is to answer the question that how teaching training content will be helpful in transforming negative attitudes of school teachers into positive ones and how highly motivated students are willing to learn in all situations.

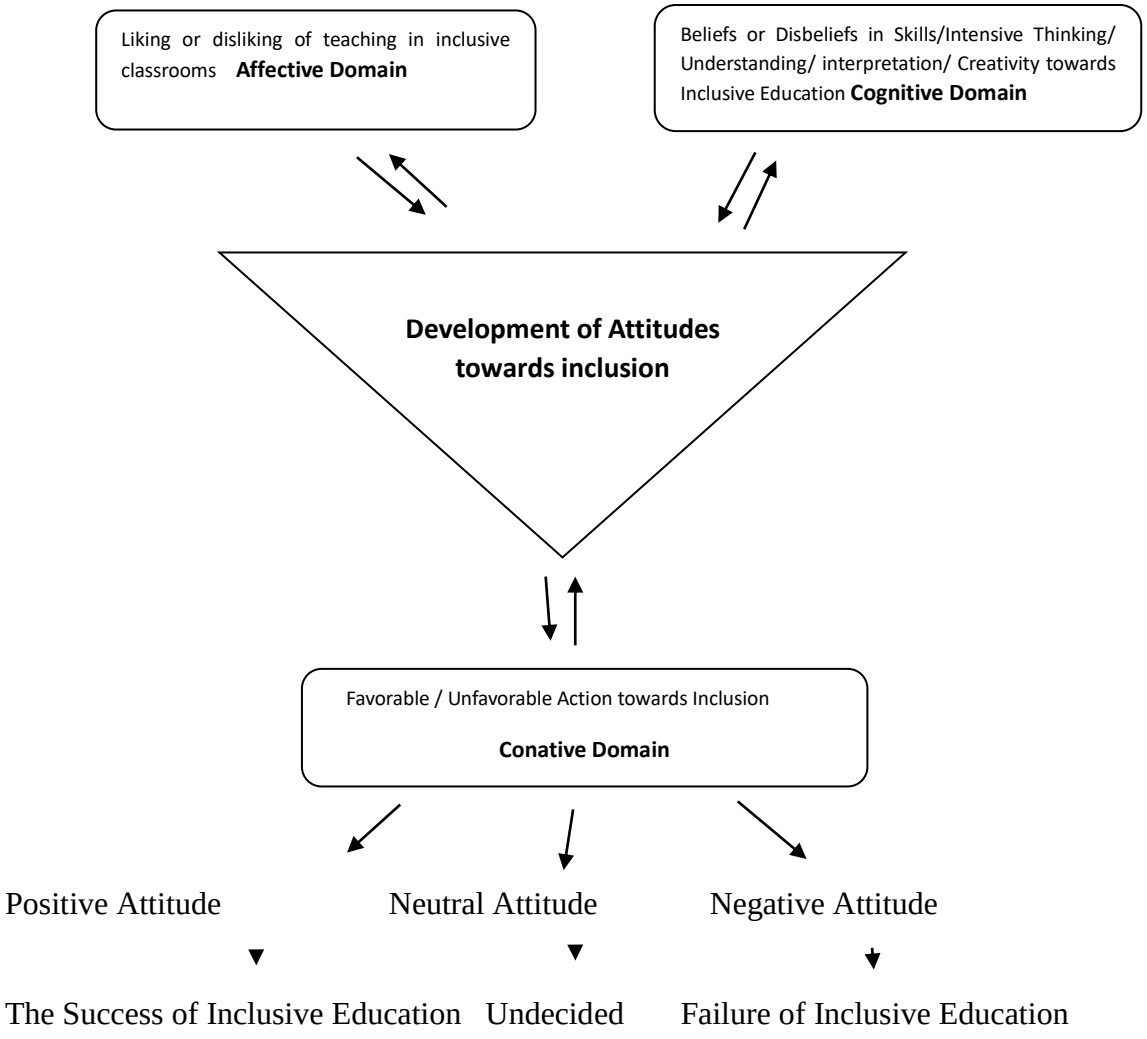


Figure 1

2. Objectives of the study:

1. To understand the basic neurophysiology of Learning.
2. To understand the neurodevelopmental cause of disability.
3. To uplift the cognitive perspective of teachers towards Inclusive education.
4. To review the impact of Motivational and Emotional Factors of an individual on Learning.

Limitations:

- Under the process of the neurophysiology of Learning, this study was limited to the function of the Fore-brain in the process of learning.
- This study was delimited to the information processing of five sensory nerves.
- This study was delimited to explore the significance of understanding the neurophysiology of learning in shaping teachers' cognitive attitude towards inclusion.

Learning and Neurophysiology of Learning

Learning: Clark Hull had given a hypothetical-deductive method of learning which is a logical structure of postulates and theorem (Singh, 2015) in a simplified way we can conclude that it is a process of forming a series of S-R Bonding or restructuring of previously Learned S-R bonding. Where S stands for Stimulus and R stands for Response. Stimulus is inputs generated within the surroundings of an individual that could be in the form of Visual, Audio, Taste, Touch, temperature, smell, and kinesthesis information. These inputs are the basic unit of information that is further processed by the nervous system so that one can perceive surroundings. This science of information processing validates that learning is a process of bringing changes in learned cognitive structure or of structuring new cognitive structure to adjust and accommodate new challenging situations.

Neurophysiology of Learning: The nervous system plays an important role in the perception and recognition of surroundings. It comprises of brain, Spinal cord, and peripheral nerves. The brain further divides into three parts forebrain, midbrain, and hindbrain. The forebrain is the largest part of it, also called the cerebrum which divides into two halves right and left hemispheres connected with the corpus callosum fiber bundle. Functionally cerebrum is divided into four lobes Frontal Lobe, Occipital Lobe, Temporal Lobe, and Parietal lobe. Each lobe is

made up of fine thread-like structures called neurons. The neuron is the basic functional and structural unit of the nervous system that generates electrical signals called **action potentials**, which allow it to transmit information throughout the body quickly.

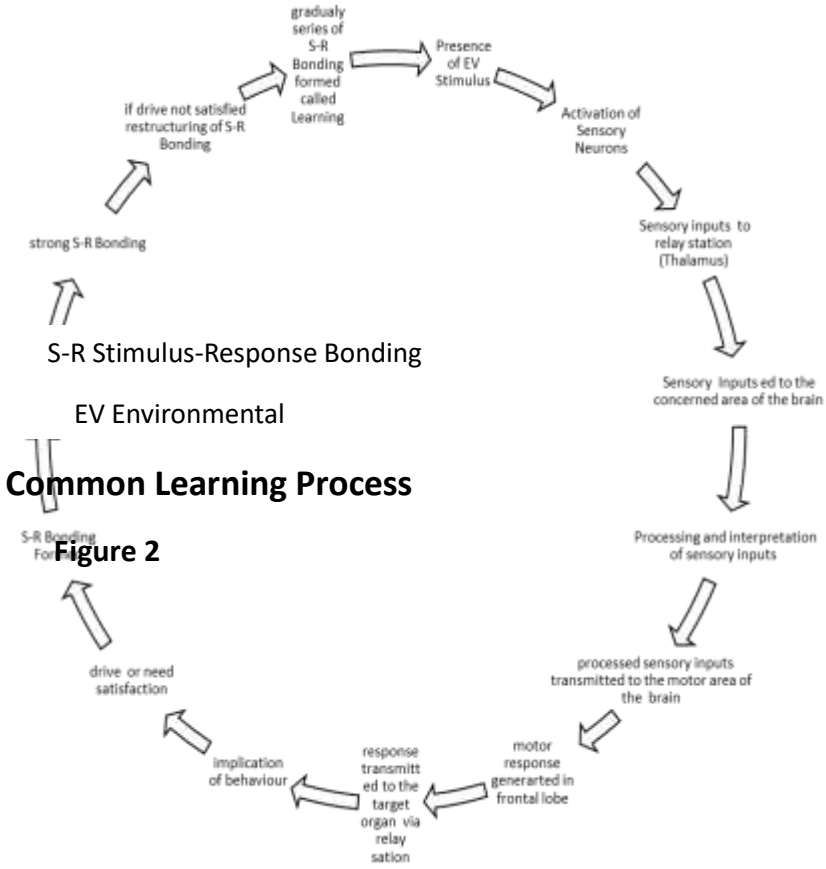


Figure 2

There are three types of neurons sensory neurons, motor neurons, and associated neurons. Among Sensory neurons are the neuron that receives inputs from the external environment as the Optic nerve receives visual inputs, the Auditory nerve receives audio input, the olfactory nerve for smell sense, the glossopharyngeal nerve for taste sensations, and peripheral efferent neurons receive senses from all over the body or skin for touch, temperature, and pain.

Neurophysiology of learning includes synaptic plasticity, neural networks, and the brain associated with memory and cognition. it involves the transmission of sensory inputs throughout the neural network of the body, recognition, understanding, memorizing of the inputs, and generating motor response for the same. Another system that plays a vital role in learning is the HPA system (Hypothalamus, Pituitary, and Adrenal Gland System), which involves the incorporation of the hormonal response of the body with neural networks, this

system is responsible for the motivational and emotional influence of learning. These two-system processes are involved in learning and bring all cognitive, affective, and conative changes in a person and form a set of cognitive structures for specific stimuli. Human beings perceive their environment with the help of five important sense organs (Eye, Ear, Nose, Skin, Tongue) called doors of knowledge. Neurophysiology for each sensory input could be understood as follows

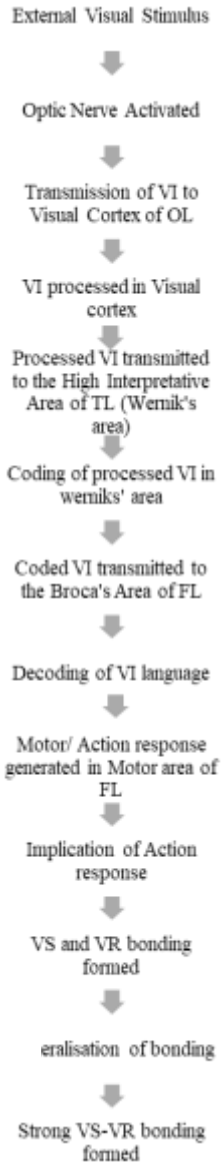


Figure 3

1. Processing of Visual Input (VI):

The visual sensory neural network helps in receiving and recognizing visual inputs within the surroundings as color, shape, size, etc termed as visual stimuli **(S).** These visual inputs are actually sensitized by the optic nerve (ON) present in the retina of the eye. Electric Impulses for visual inputs or stimuli are generated and transmitted to the visual cortex part of the Occipital Lobe (OL) of the cerebrum situated in the posterior region of the skull. The visual effects or images generated here and further passed to the highly interpreted area of the temporal lobe (TL) called Werniks' area. In this area coding for visual impulses is performed and then passed to the Broca's area of Frontal Lobe (FL) of the cerebrum where decoding of coded VISUAL IMPULSES performs and the message transfers to the motor cortex area of the frontal lobe. In the motor cortex area motor response is generated for the external stimuli and transmitted to the target organ of **Figure 3** ich could be seen in the form of a unit of behavior or response **(R) and** connection or bonding between Visual Response (VR) and Visual Stimulus (VS) formed. Further, VS-VR Bonding generalized for the same stimuli when required which resulted in the formation of strong VS-VR bonding. It can be seen in Figure 3. Along with this

visual network process of visual stimuli possible range of disability that we can see is Blindness, low vision, and Angular agnosia with growth and developmental disorder or accidental hazards.

2. *Processing of Audio/ Sound Input:* The sensory organ that helps in the recognition and perception of external sound input is the ear, which is further divided into the External ear, middle ear, and inner ear and the nerve responsible for converting sound input into electric sound impulses is Auditory nerve. Sound input first enters the external ear then travels to the middle ear and then to the cochlear part of the inner ear where electric impulses are generated for the audio input and transmitted to the Wernicke's area of the Temporal Lobe (TL) of the cerebrum. Again, Wernicke's is a high interpretation area of the cerebrum where coding for sound impulses performs to generate meaningful words or sentences for the sound impulses. Further, these impulses pass to the Broca's Area of the Frontal Lobe (FL) to decode impulses and then pass to the motor area of the frontal lobe to generate an action response which is then transmitted to the target organ that we all see in the form of a unit of behavior could be express as Audio Stimulus (AS) and Audio Response (AR) Bonding. Further, an individual generalized these newly formed AS-AR bonding for the same stimulus and strong AS-AR Bonding formed.

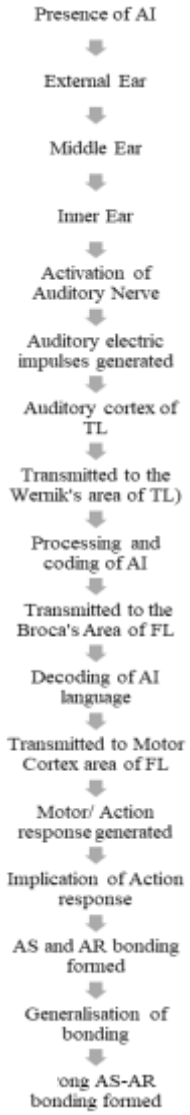


Figure 4

Learning about surroundings with this sensory neural network (Ear, Auditory Nerve) can be affected if a person has Conductive Hearing Loss (external, Middle, Inner Ear related disorder), CNS (cochlear nerve) Hearing loss, and Werneck's' Aphasia.

3. ***Processing of Smell Input****:* Another sense organ is the Nose to recognizes the presence of smell in the surroundings. The olfactory sensory nerve presents in the nasal cavity to perceive smell impulses or chemicals. This nerve generates electric impulses for Smell inputs then transmitted to the olfactory bulb present in the temporal lobe. In the Temporal lobe, smell impulses are processed in the Werniks' area and then transmitted to the Broca's area of the Frontal Lobe of the Cerebrum. Further, In the same way as other sense organs decoding of smell senses is done here and then transmitted to the motor area of the frontal lobe to generate motor response for the smell stimuli and further transmitted to the target organ which could be seen in the form of a unit of behaviour. As A result of this processing and interpretation new SS (Smell Stimulus) and SR (Smell response) bonding formed. After generalization of this bonding to the same stimulus strong SS-SR bonding formed.

Figure 5

4. ***Processing of taste/tongue Input:*** The fourth source of the recognizing environment is Taste. For which tongue is present in the human body inside the mouth. Taste senses are received by the glossopharyngeal nerve and transmitted senses from the tongue to the temporal Lobe of the cerebrum where taste senses are processed and transmitted to the Wernicke's area of TL. Then coding come into the process and is transmitted to Broca's area of the frontal lobe where decoding of the senses occurs and is passed to the motor area of the Frontal Lobe (FL) where action or motor response is generated for the taste senses and conveyed to the target organ that is resulted in the formation of new TS (Taste Stimulus) and TR (Taste Response) bonding after generalization of this bonding for the same stimuli strong TS-TR Bonding formed.

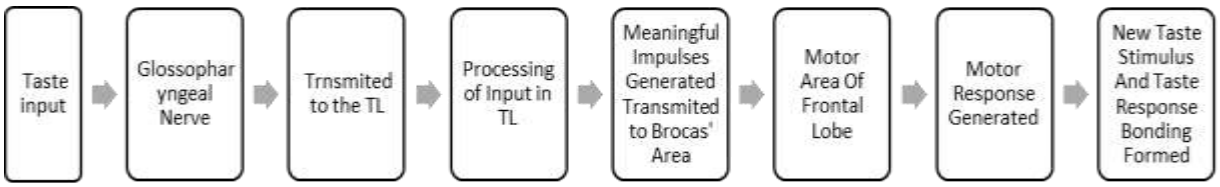


Figure 6

5. ***Processing of Somatic and Kinesthesis Input:*** The fifth important sense organ is the skin which contains receptor neurons for touch, pain, and thermal stimuli even identification of an object by touching for its shape and size too. Receptors from the skin all around the body receive senses for touch temperature and pain and are transmitted to the Parietal Lobe (PL) of the cerebrum. This lobe is also responsible for kinesthesis stimulus perception (*Spatial intelligence). Impulses* are transmitted to the Wernicke's area of the temporal lobe and then coding of the Somatic stimulus occurs and is transmitted to the Broca's area of the Frontal Lobe. After decoding the senses motor response was generated in the motor area of the frontal lobe for the target organ and SS-SR (Somatic Stimulus-Somatic Response0 bonding formed after generalization of the SS-SR bonding for the same stimulus Strong SS-SR Bonding formed.

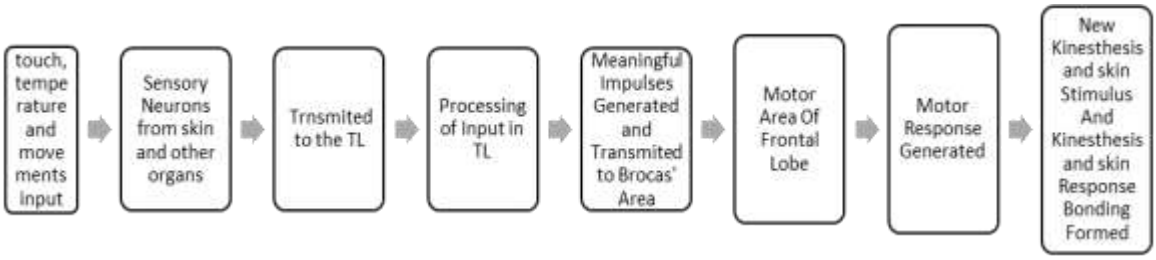


Figure 7

Learning Disabilities such as Dysgraphia, Dyscalculia Dyslexia are related to the Parietal Lobe of the cerebrum.

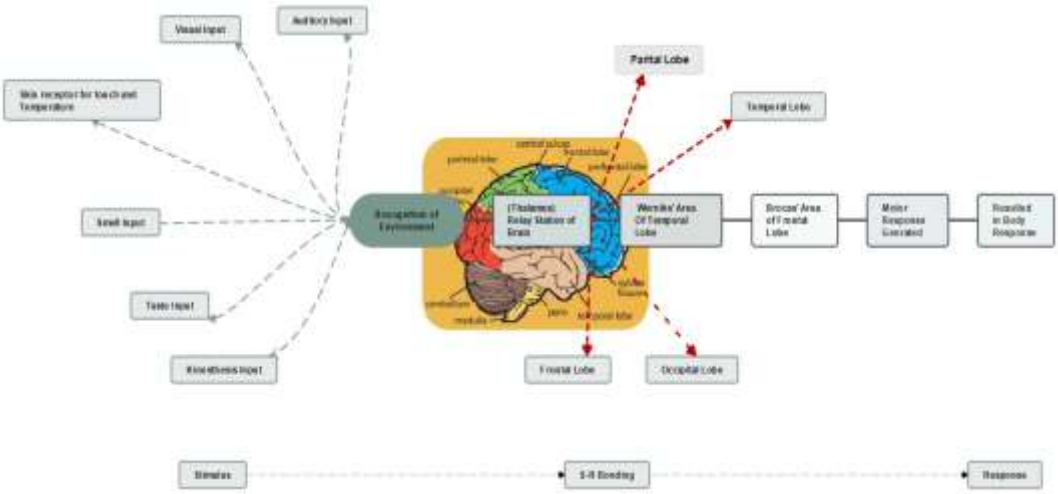
Frontal Lobe of the Brain: The frontal lobe is the anterior and largest part of the cerebrum which is more highly developed in humans than in other animals. High levels of cognitive skills like planning, problem-solving, attention, decoding of interpreted information by the Wernicke's area, judgment, decision-making, thought manipulation, and control motor skills, are performed by the frontal lobe.

Effect of Motivational and Emotional Factors on Learning: Motivation and emotions play a crucial role in learning, especially for children with special learning needs. When children feel supported and valued, they are more likely to be motivated to learn. On the other hand, when children feel demoralized or exploited, they are more likely to withdraw from learning. Neuroscience research has shown that positive thoughts and emotions can have a positive impact on learning. When we think positively, our brains release hormones that help us to focus and learn. On the other hand, when we think negatively, our brains release hormones that can make it difficult to focus and learn. Because of this, it's crucial to provide kids with special needs with a supportive learning environment. Support, inspiration, and a sense of community are things we

must provide them. Children are more likely to be motivated to study and succeed if they experience support and value from adults. A complex system of hormones and glands called the hypothalamic-pituitary-adrenal (HPA) axis aids in your body's reaction to stress. A hormone known as corticotropin-releasing hormone (CRH) is released by your hypothalamus in response to stressful situations. Adrenocorticotropic hormone (ACTH), which is produced by the pituitary gland, is released as CRH travels there. The production of the hormone cortisol by the adrenal glands is triggered by ACTH. By elevating blood sugar and reducing immunological function, cortisol aids your body in dealing with stress. Since the HPA axis is a negative feedback loop, as cortisol levels rise, the hypothalamus receives a signal to stop secreting CRH. Cortisol levels are lowered as a result of this. However, the HPA axis can become overactive and cortisol levels might rise excessively if you experience prolonged stress. Numerous health issues, such as anxiety, depression, weight gain, and heart disease, might result from this.

The implication of Neurophysiology of Learning in Understanding the learning needs of CWSN: It is clear from the explanation above that the sense organs of sight, hearing, smell, taste, and touch, as well as skin, are crucial for recognizing and perceiving the world. The brain can be stimulated from the outside through these organs.

The Werniks region, various ganglionic structures in the temporal lobe, Broca's area of the frontal lobe, and the vast frontal cortical area ultimately have a huge and vital role in processing, interpreting, and manipulating these stimuli. The conclusion that follows is that



1. Even if a person's sense organs aren't fully working, that doesn't imply they can't be trained to learn new things or to become oriented in their environment. He or she is actually capable of picking up information from their immediate environment using other healthy senses, which allows us to design our school's curriculum to produce a variety of sensory stimulation that the brain can then interpret. That is why the term disabled was

replaced by the term CWSN (Children with Special Needs of Learning). They can only do this when they insist on having their demands satisfied in terms of content and teaching-learning strategies.

2. If neuroscience of learning is to be incorporated into teacher training programs, it will be beneficial in enhancing teachers' knowledge of the physiology of learning, their beliefs, and ideas regarding the role of various sense organs in learning, and it will alter their mindset in a favorable way towards working in inclusive classrooms. They will be able to understand that these pupils are capable of performing far better than other students.
3. It will undoubtedly aid educators in developing favorable cognitive attitudes towards the implementation of inclusive education and prepare them to develop their inclusive practices and abilities.
4. Conative and emotional domains will eventually shift in a good direction as a result of teachers' altered or positive cognitive attitudes towards inclusive education. Positive teachers can also influence the community of parents, children with disabilities, and other students to embrace learning in an inclusive environment.
5. Additionally, it will be beneficial to comprehend the underlying developmental causes of the incapacity to perceive the environment, and teachers can actively participate in the early diagnosis of disability with the aid of an assessment and behavioral checklist.

Conclusion: In India, NCTE (National Council for Teacher Education), is a statutory body of the Government of India that regulates and develops teacher education in the country. NCTE frames the syllabus for various teacher education programs, such as B.Ed, D.El.Ed, B.P.Ed, M.Ed, etc. It could be seen that the B.Ed syllabus of many states in India still has no content related to the neuroscience of learning and from the above discussion it could be understood how having the knowledge of the neuroscience of learning will affect the understanding of fundamental neural demand of learning new things and hence help in changing beliefs, knowledge, and understanding of teachers of general schools the actual demand of learning of children with diverse learning needs finally it will produce cognitively positive attitude in teachers as well as positive affective and positive conative attitude. Critically it will be still challenging until we will not work on physical (barrier-free Environment) and social (societal beliefs and disbeliefs)

inclusion aspects but attitude is considered a strong variable to work successfully and effectively in a challenging environment with collaboration of other institutions (Health, Education, Samgra Shiksha Abhiyan, Special Teachers Support, Resource centers etc.).

Therefore, it is advised to:

1. Review the teacher training curriculum for the incorporation of the neuroscience of learning and behavior assessment checklist content.
2. Special school visits and training must be included in teachers' internship workshops.
3. Teacher training curriculum must provide good knowledge of the cause, diagnosis checklist, and learning needs of different mild to moderate disabilities.

3. In difficult terrain, we might work with other supportive resource centers of education or we would need a well-equipped and restricted free school infrastructure.

4. Provide a supportive, Inspirational, and motivational environment to the children with special learning needs. They must feel welcomed in the school by the teachers, students, and other community members.

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Cite Your Article as:
Dr. Rubee Mamgain Thapliyal. (2024). IMPORTANCE OF NEUROSCIENCE OF LEARNING IN SHAPING COGNITIVE ATTITUDE OF TEACHERS TOWARDS INCLUSION IN EDUCATION. In Scholarly Research Journal for Humanity Science & English Language (Vol. 12, Number 62, pp. 39–51).
Zenodo. https://doi.org/10.5281/zenodo.10939684