Brain-Based Approach for Optimal Learning and Teaching

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Abstract: This paper introduced a new approach for teaching and learning. Presently, the Brain-based approach is being implemented in many disciplines of learning across the world, but several dilemmas hindering the implementation of this approach for learning and teaching. As an attempt this paper provided theoretical base to understand what is Brain-based approach and its principles along with implications to the teaching and learning and plan their teaching and learning round the three elements of Brain-based learning for optimal learning and teaching.

IndexTerms: Brain-based approach, relaxed alertness, orchestrated immersion, active processing

1. Introduction

According to Caine and Caine (1994), Brain-based approach is an outcome of learning theories of neurons in human brain. The revolution in information technology through the brain scans; PET, MRI, fMRI, EEG and MEG, paved the way to look into brain and read its response and the process of learning in the particular environment. The discoveries not only in cognitive neuroscience but also from other disciplines of science that understand human brain changed the perspective of teaching and learning process in the field of education. According Caine and Caine (1994), these discoveries showed that the human brain has its own function to learn as it is for lungs to breathe and heart to pump blood. Though each human brain is unique, it has some common features irrespective of age, sex, nationality, and cultural background. They are:

- It has the ability to detect the patterns and to make approximations.
- It has a phenomenal capacity for different types of memory.
- It has the ability to self-correct, learn by way of external data, and self-reflect from every experience.
- It has inexhaustible capacity to create (p.3).

Though all the teachers have these abilities, many of them are unable to teach well because they have not understood the real complexity and the learning behavior of the brain particularly, when it functions optimally. Leslie Hart (1983) was the first amongst the authors with his ground breaking book "*Human brain, human learning*" to write about brain from the perspective of education. He used the terms "brain compatible" which was referred to education that matched the settings and the nature of the brain and "brain antagonistic" which was referred to education that forces brain to comply with established arrangements disregarding the organ of learning and how it learns best. Caine and Caine (1994) say:

> Although all learning is brain based in some sense, to us brain-based learning involves acknowledging the brain's rules for meaningful learning and organizing teaching with those rules in mind. That is when we are teaching to the human brain (p. 4).

Jensen (1998) drew implications for learning through interpreting brain science at 4 levels: theory at level1; theory illuminated by discovery or experiment at level 2; wide spread documented clinical trials at level 3; and conformity of action research at level 4. He agreed with the critics of brain-based education who argued that brain-based education was merely a "field" which was composed of scholars, consultants, publishers, staff developers, neuroscientists, conferences and school programs but not a "domain" which had accumulated a

clear set of values, qualities, criteria for acceptance and validity. Jensen (2008) has termed it as an "approach" which is cautionary one that sticks with the truth. Caine and Caine (1990) opined that brain-based learning is not a separate movement in education but it is an "approach", from which all education eventually gets benefit.

2. Definition and Scope:

Brain-based education can be best understood in three simple terms: engagement, strategies, and principles. It is defined as the "engagement of strategies based on the principles derived from an understanding of the brain" (Jensen, 2008). The definition does not say strategies given by neuroscientist, or principles derived from neuroscience. It says, 'from understanding of the brain'. The disciplines that deal with the human behavior focus on understanding of the brain. Therefore, understanding may come from any branch science. Antonio Damasio says:

> The relation between brain systems, complex cognition, and behavior can only be explained satisfactorily by the comprehensible blend of theories and facts related to all the levels of organization of nervous system from molecules, cells, and circuits, to large scale systems physical and social environments…..We must beware of explanations that rely on data from one single level whatever the level may be (Liston, 2001, p. 2).

Therefore, brain-based learning does not belong solely to any one of the branches of science. It is multidisciplinary by form and interdisciplinary by functions. Difficulty does not lie in understanding the anatomy of human brain and its functions but in understanding its complexity, vastness, and real potentiality.

3. Objectives of Brain-Based Learning

At present, rote memorization and re-production has been a popular criterion for academic performance. According the recent studies, the brain is not pre-cast but made of experiences. As the brain is meaning maker, a new piece of information shall be attached to the previous learnt data. One of the objectives of brain-based learning is to move from passive learning to experiential learning. Moreover, the emotions are considered hooks to fix learning in mind. It includes teaching to individual differences, diversifying teaching strategies, and maximizing the brains natural learning process (Tileston, 2005). So conclusively, the objectives of Brain-based approach are to promote emotional, meaningful, and experiential learning (Caine & Caine 1990).

4. Brain Functioning for Optimal Teaching and Learning

Leslie Hart is one of the first writers who wrote on the issues of brain from the perspective of education. He says that teaching without awareness of how brain functions and learns is like designing a glove for a hand without knowing the shape and movements of the hand. He further continued that human heart has function to purify and pump the blood and lungs are to breathe, and therefore the brain has function to learn (1983). If the school is the place of learning, then the organ of learning is "the brain" which must be understood and accommodated (Ibid.). In the light of his arguments and explanations, the methods of teaching and learning that were designed without sufficient knowledge of the functions of the brain considered ineffective but the design that suit to the functions of brain turns to be more fruitful. So the parts of the brain and their functions were discussed briefly below:

Human brain and its parts

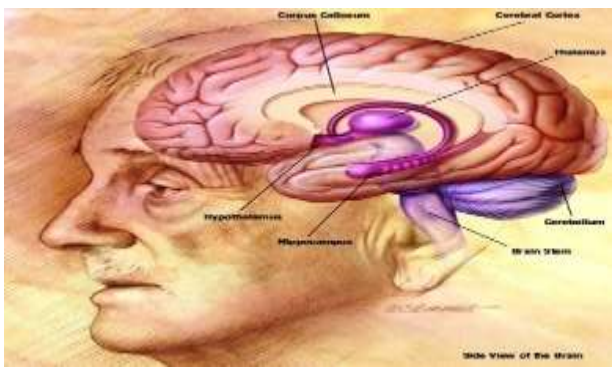

Image: 1 Retrieved from: https://commons.wikimedia.org/wiki/File:NIA_human_brain_drawing.jpg

The above image shows different parts of the human brain. Nicola Call and Feather Stone presented the human brain into three main parts at macro level: Brain stem, the limbic system, the cerebral cortex. These parts can be divided into specific areas with individual and complex roles to play. Some parts process the information from the senses while some of them deal with the aspects of emotional responses. Some of them are responsible for certain types of memory while others help to read cues from the people and make physical and emotional responses (2010). The following table shows the name of the part of the brain and its function:

Table: 1 Name of the parts of human brain and their function

Sl.no.	Name of the part	Function
1.	Brain Stem	It controls autonomic functions, which are not in our conscious control but essential for our survival. It regulates our life supporting mechanisms such as 'heart rate', 'breathing' and 'fight or flight' responses to perceived danger. High order of thinking could be derailed during the times of stress (Wolfe, 2010).
2.	Limbic System	The lower structure of limbic system manages our basic emotional responses and higher structure manages responses that are more intellectual. The former causes behavior like blushing or shaking against criticism; the latter prepares a measured response to the criticism (Call & Featherstone, 2010) It is responsible for sleep, attention, body regulation, hormones, sexuality, smell and production of most brain chemicals (Jensen, 1998).
3.	Cerebral Cortex	It is also called 'the thinking brain'. It is physically separated into two hemispheres. Each hemisphere has specific functions and communicates each other to do complex functions (Call & Featherstone, 2010).
4.	Thalamus	It is responsible for regulating the perception and vital functions of the body. Thalamus works as a relay station between the sense organs and the cortex. Only one exception is olfactory system, which sends smell stimuli directly to the cortex (Wolfe, 2010).
5.	Hypothalamus	It signals when salt and sugar levels are high and regulates sex drive, sleep, pleasure, and aggressive behavior. Increase in the rate of heartbeat, respiration and palms getting sweaty under a scary situation are functions of hypothalamus. It is also one of the organs to control 'fight or flight' response (Binney & Janson, 1990).
6.	Amygdala	Research studies show that amygdala forms emotional memories, which can trigger responses without corresponding to conscious recollections, which link responses to a particular event. This may be concerning to panic attacks and unreasonable phobias (Carter, 1998).
7.	Hippocampus	It not only holds immediate past but also dispatches the memory to the cortex where it will be stored in long-term memory (LeDoux, 1996). Hilt studied that if an episode is fully decoded in long-term memory, hippocampus is no longer needed to retrieve it (1995).
8.	Cerebellum	It receives information from motor cortex to initiate a movement after computing muscles to involve. It is responsible for balance, posture, motor

		movements, and some concepts of cognition (Wolfe, 2010).
9.	Occipital Lobes	They have the primary brain centers for visual stimuli and also called visual cortex. They have multiple sub-divisions and each of them has a role to process visual data coming into brain. The stimuli, which reach visual cortex, are processed by primary visual area where millions of neurons are involved to process different aspects of vision (Wolfe, 2010).
10.	Temporal Lobes	These lobes are responsible for processing auditory stimuli. There are several subdivisions to correspond with hearing language and some aspects of memory.
11.	Wernicke's area	It is critical to speech. Comprehension and putting words in correct syntax are the basic functions of this area while speaking (Wolfe, 2010).
12.	Parietal Lobes	They maintain focus or spatial attention. When attention shifts from location to location, much activation can be seen in these lobes. If it is less meaningful stimuli, attention wanes (Wolfe, 2010).
13.	Frontal Lobes	They perform more complex duties such as moving the parts of the body at will, thinking about past, planning for the future, focusing our attention, reflection, making decisions, solving problems, and engaging in conversation (Wolfe, 2010).
14.	Broca's Area	This part enables us to speak. It is connected to Wernicke's area in the temporal lobes with the bundle of nerve fibers called "arcuate fasciculus", which is very important because formation and appropriation of words first take place in this area and then relayed to Broca's area to be translated into corresponding sounds and then passed to motor cortex for vocal production (Ackerman, 1992).
15.	Prefrontal cortex	It is responsible for highest forms of mental activities. Research findings shows that a part of prefrontal cortex is critical for emotional self-regulation (Seigel, 1999).
16.	Right Hemisphere	Right hemisphere not only decodes external information and helps our overall understanding of what we hear or read but also assembles the whole view of the world about specialization of right hemisphere (Ornstein, 1997).
17.	Left Hemisphere	It is dominant for language and speech. It is observed that when writing a letter, the left hemisphere showed more beta activity. The opposite was true in case of a person arranging blocks (Ornstein, 1997).
18.	Corpus Callosum	Roger Sperry, a neuroscience researcher contemplated that cutting corpus collasum might prevent electrical activity that used to pass from one hemisphere to another had become true (Ornstein, 1997).

The table presents briefly 18 important parts of human brain and their functions in the understanding of neuroscientists and psychologists for the process of learning and memorizing. The psychological support and theoretical foundations were discussed in detail in the following.

5. Principles of Brain-Based Learning

Renete Nummela Caine and Geoffrey Caine (1994) accumulated most of the findings of research relating to brain and formed them into 12 principles as general theoretical foundations to apply to learning and teaching processes in their significant book "*Making connection: Teaching and the human brain* ". They are simple and biologically sound to re-conceptualize teaching and learning by taking educators out of traditional frameworks that dominated almost a century. Behavioral model of learning and teaching must be put to rest. It shall be replaced by open quest subjected to limitations and dictations of human brain itself.

5.1. Principle 1: Brain is Parallel Processor

Ornstein and Sobel (1987) studied that human brain always performs many things at a time. Thoughts, emotions, imaginations, and predispositions run simultaneously and interact with other modes of brain processing like maintenance of health and general and cultural knowledge.

Implication: The teaching must be smart to acknowledge parallel processing nature of the brain. The smart teaching must be based on theories and methodologies, which make possible orchestration. No single method can encompass the enormous complexity of human brain. Teachers have to prepare a frame of reference that enables them to select a suitable method or approach that enhances meaningful and experiential learning.

5.2. Principle 2: Learning Engages Entire Physiology

Hart (1983) stated that brain is an incredible organ like heart and lungs, which work according to physiological rules. Learning is as natural as breathing, which can be either inhibited or facilitated. According to Diamond (1985) growth of neurons, nourishment and synaptic interactions together contribute to perception and interpretation of experiences. Stress and threat affect the brain unlikely from peace, happiness, boredom, challenge, and contentment. Ornstein and Sobel (1987) opined that the schools and life experiences do the wiring of brain. Anything that affects the physiological and psychological functioning will influence the learning

Implication: Brain-based teaching must incorporate the aspects of stress management, nutrition, exercise, drug-education, and other issues of health management. Some drugs that inhibit their learning should be curtailed though they were prescribed. Besides this the learners must be given sufficient time to process and consolidate learning. The growth of the brain and body along with individual and natural rhythms and cycles will influence the use of time to process learning. Healthy children outperform others by as many as five years. So expecting the same level of achievement from all the learners is not appropriate. The designing of activities that give good exercises along with the content and mental growth are recommended. According to Hannaford (1995), though brain claims 2% of the weight of adult it consumes 20% of the total energy. Brain needs water about 8-12 glasses per day for optimal functioning. Dehydration is a common problem in the classroom, which leads to impaired learning. Jensen (1998) pointed that oxygen is another critical factor for learning. The brain uses one fifth of the body's oxygen. The quality of air boosts higher levels of attention, mental function, and healing. Oxygen flow into the brain will improve the memory. So good teacher not only prepares a strategy to input content in the context but also creates comfortable environment for optimal learning.

5.3. Principle 3: The Search for Meaning is Innate

O'keefe and Nadel (1978) studied that making meaning out of experience and consequential necessity to respond are automated activities of the brain. The basic functionality of human brain is to search for meaning as long as it has life. The brain automatically notices familiar stimuli while looking for and responding to new stimuli. This process will take place in every waking moment and sometimes while sleeping also. Springer and Deutsch (1985) confirmed that the brain is a meaning maker, which cannot be stopped but only channeled and focused. When the stimuli are routine, the very survival function such as 'meaning making' becomes sluggish. This is the reason certain activities like rote learning makes some parts of the brain cease to function and turns to the state of down shifting which is psycho-physiological state of the brain where it feels helpless.

Implication: The teacher has to provide rich environment with stability and familiarity while providing novelty, challenge, and things to be discovered to appease the curious and hungry minds. The content needs to be generally exciting and meaningful to the learners by giving them many choices.

5.4. Principle 4: The Search for Meaning Occurs through Patterning

According to Hart (1983) and Rosenfield (1988), brain is considered both scientist and artist. As a scientist, it first understands or decodes the given patterns and the guiding rules that may be logical, linguistic, rhetorical, or mathematical and it creates unique patterns of its own as an artist. The brain is accustomed to perceive and generate. If anything appears meaningless, it cannot perceive. All meaningless patterns are isolated pieces of information. The brain has the ability to integrate some isolated pieces of information when they are acknowledged in the teaching or material. So isolated information, which appears meaningless earlier will be assimilated when its natural capacity of integration is addressed.

Implication: The patterning nature of brain cannot be stopped but it can be directed. Problem solving, critical thinking, and daydreaming are the ways of patterning. When the teacher prepares some material to be presented, he or she must present it in a way that brain allows patternising instead of just imposing on them. The activities like "time on task" do not serve the purpose of creating patterns because the learners may be engaged with the activity with the absence of mind. Sufficient time is to be given to the learners to internalize and consolidate the learning. If the task has unachievable challenge, it triggers stress and turns on the learners' 'fight or flight' mode. Teaching can become effective when it enables the student to create personally meaningful patterns. The advocates of thematic teaching (Kovalik, 1986), integration of curriculum (Shalley, 1987) and life-relevant approaches will endorse this type of teaching.

5.5. Principle 5: Emotions are Critical to Patterning

Ornstein and Sobel (1987) stated that the separation of emotions from cognition is not possible. The learning will be influenced and organized by the emotions in mind in terms of expectations, personal biases and prejudices, degree of self-esteem and need for social interaction. Emotions motivate the student to adjust his focus on incoming stimuli. According to Call and Featherstone (2010), Abraham Maslow propounded a theory of motivation and stated that certain needs of brain must be met before making the brain ready to learn. His hierarchy was arranged in pyramid like structure, which begins at bottom with physiological needs and continues through safety needs, belonging needs, self-esteem needs to self-actualization. Rosenfield (1988) stated that emotions are very critical to memory, since they facilitate the storing and recalling of information. If the content is emotionally linked, it will be recalled with less effort and stored in long-term memory. Any lesson or life experience that is attached to emotions continues to reverberate long after the event, which triggered the recall.

Implication: Teachers must reach the learners before teaching them. They have to understand the emotions and feelings of the learners. Emotional relationship with the learners is recommended for effective learning because the vacuum between the teacher and learners will be the valuable determiner of optimal learning. Emotional climate in the class will be developed with mutual respect and acceptance. The reflection of the learners and teachers on the classroom management, teaching and learning activities is to be encouraged. Cooperative learning approaches will support this idea of reflection along with metacognitive approaches. The emotional color between the student and teacher will depend on the sincerity and encouragement that the teacher, student, and administration of school offer each other.

5.6. Principle 6: Every Brain Simultaneously Perceives and Creates Parts and Wholes

According to Springer and Deutsch (1985), the brain laterality is supported by evidence from scientific studies. The significant difference has been identified between left and right hemispheres of the brain. Though there is difference between the two hemispheres, they are inextricably interactive in a healthy person irrespective of his dealing with mathematics, science, or arts (Hand, 1984; Hart, 1975). Both the

hemispheres exchange information through corpus collasum. One hemisphere is to disintegrate information into small parts in order to analyze the property of information while other hemisphere blends back particles to understand it as a whole or series of wholes (Caine & Caine, 1994).

Implication: Teacher has to select suitable activities to support coordination between the two hemispheres of the brain. Good teaching perceives learning as cumulative and developmental. Both the hemispheres are conceptually interactive and derive meaning from each other. Instead of struggling to find which hemisphere dominates the other or which one reduces information into parts or which one perceives it as a whole, their very coordinative nature is to be acknowledged in the teaching process. Therefore, it is suggested that learning material should be separated into inter-related parts that will be processed by brain to connect them together into wholes.

5.7. Principle 7: Learning Involves both Focused Attention and Peripheral Perception

O'keefe and Nadel (1978) observed that the brain not only absorbs information, which is paid attention to but also recognizes information or signals out of the place of direct attention. Without turning the attention from the point, the human brain captures information, which is within gaze of sideways of the eye like color of walls, someone signaling or going to do something harm. Peripheral stimuli are the signals that are in the field of direct attention but not consciously noticed. The brain has a natural ability to respond to entire sensory context in which teaching or conversation takes place. Lozanov (1978a; 1978b) explained that every input from the outer world would be coded, associated, and symbolized by human brain. Everything that people hear and see will be packed with complex meanings. Peripheral information however will be stored automatically to facilitate learning unconsciously.

Implication: According to Barzakov (1988), the teacher should not organize the material outside the focus of learners' attention. The charts that regulate behavior along with designs, illustrations, paintings, and works of art should be displayed in the classroom. Items that are exhibited must be changed frequently to reflect changes in learning focus. It is recommended that the music can be used in the class to facilitate natural acquisition process. The state of being of a teacher reflects in his or her skin color, muscular tension, posture, eye movements and breathing rate and highly influences the learning process. Sometimes it poses threat to the learners believing that the teacher is serious so he will punish. Teacher has to read interest and enthusiasm of the learners and engage them through his own enthusiasm, coaching and modeling to relate unconscious signals to the value of what is being learnt. Inner state of the teacher will be deciphered by the learners at any level or situation. Lozanov (1978a) termed congruence of inside and outside of person as "double planeness". Therefore, teacher has to practice, what he or she preaches and show true compassion rather than the fake one and maintain honesty and simplicity so that the learners listen to the teacher with value.

5.8. Principle 8: Learning Involves both Conscious and Unconscious Process

It is amazing to know that people learn much more in a state of unconsciousness than in consciousness. Peripheral information enters the brain without our awareness and interacts at unconscious levels. Lozanov (1978b) says, "Having reached the brain, this information emerges in the consciousness with some delay or it influences motives and decisions" (p.18). Information at unconscious level gives experience of the actual content and purpose of information. Thus, people remember more of what they experience than what they are told. So part of the learning will take place through instruction and the remaining part from unconscious process (Caine & Caine, 1994).

Implication: The teacher has to plan his teaching to give much experience of content at unconscious levels to maximize the learning. The allocation of maximum time for instruction and studying does not give any experience to the learners because of lack of adequate process of giving rich experience. The "active processing" allows learners to review the content they are learning, how it is learned, which helps them to take charge of their own learning, and make meaning from information. Active processing is a reflection on information presented, which includes using metacognitive activities. When each of the learners has his or her

own learning style, the teacher has to address them by using metaphors and analogies that assist them to reorganize the material meaningful for them.

5.9. Principle 9: Two Types of Memory: A Spatial System and a System of Rote Learning

Nadel, Wilmer, and Kurz (1984) identified that human brain has a spatial memory system, which permits instant memory of experience that does not require any rehearsal. Certain aspects like, where a person was and what he had for dinner last night do not require any memorization techniques to remember. O'keefe and Nadal (1978) noticed that there is at least one memory system in human brain to store experiences in ordinary three-dimensional space. This is the natural memory system, which records peripheral information and recalls it easily. This system is always engaged and it is an unlimited memory. It is usually enriched over time with the growing items and categories and procedures people voluntarily do. This is the very system, which is motivated by novelty. It is one of the systems of memory, which searches for meaning. Another system of memory is designed to store relatively unrelated information. According to Caine and Caine (1994), Individual skills and facts need more rehearsal and are stored separately in the memory. The skills and information that need not be linked with the prior knowledge will be stored in this memory. So attempting to store and recall information, which is not connected previous knowledge, is inefficient use of the brain.

Implication: The teacher has to understand that overemphasis on the practices of memorizing the multiplication tables, spellings and the certain list of principles in various subjects will impoverish the learners. When teachers ignore the parameters of the human memory and personal world of the learners, teaching and learning become ineffective and unfruitful. As the spatial memory will be successfully evoked by novelty and previous knowledge, teacher has to design input with sufficient peripheral stimuli to enhance the unconscious learning.

5.10. Principle 10: Best Understanding and Retention When Facts and Skills are Embedded in Spatial Memory

Vygotsky (1978) studied that multiple interactive experiences incorporated with grammar and vocabulary can make a person master of his native language. The social interaction provides enough practice to internalize the native language. While using items, one can realize the meaning of the words when they are embedded in the experience. This type of embedding which enhances learning is common element in the brain-based theories.

Implication: Embedding is a complex activity that involves all the principles of brain-based learning. Spatial learning can be best invoked by experiential learning. The teacher has to prepare classroom activities that give ample scope to embed the facts and skills learned in the regular classes. Teaching must involve classroom demonstrations, projects, field trips, watching visuals, storytelling, drama, metaphors, songs, dance, and other performances. Vocabulary can be experienced through skits and stories and writing will help to learn grammar. Integration of mathematics, science, and history will give the student much more data to be experienced. Engaging all the senses in the process of immersing the learners in the multitude of complex and interactive experiences find place in spatial memory and retrieved easily for successful learning.

5.11. Principle 11: Learning is Enhanced by Challenge and Inhibited by Threat

Leslie Hart (1983) stated that appropriate challenge maximizes the learning but against the threat or stress, the learning downshifts. Combs and Snygg (1949) compared down shifting to the lens of a camera that reduces the focus. The perception field becomes narrow against threat. Hippocampus is one of the essential parts of limbic system in the brain and it is very sensitive to stress. As it serves as a relay center to all parts of the brain, some parts of the brain deny access when it perceives any threat in incoming stimuli. Therefore, learning will not be possible under the conditions of threat.

Implication: Teachers and managements have to provide relaxed atmosphere in the schools. The low-level challenge will give boredom and the high-level challenge poses threat to learning. Therefore, the level of

challenge is to be checked and it must be pitched at the level of the student. The teacher has to observe the learners continuously to find their initiative to the learning. All the methodologies, which are used to orchestrate, are determining factors of relaxed alertness.

5.12. Principle 12: Each Brain is Unique

Caine and Caine (1994) stated that though all human beings have uniform systems in the brain, their integration is varied from one another. As learning changes the brain, the previous experiences of school and life customize the working or responding nature of the brain. Therefore, the behavior of brain depends on our learning which makes the brain unique.

Implication: As every brain is unique, teaching is to be multifaceted. The teacher has to know preferred learning styles of his or her learners in order to acknowledge them in their methodologies. Varieties of choices shall be given to the learners to encompass all their needs.

6. Elements of teaching and learning:

There are three elements to be observed as checklist for implementation of Brain-based approach at pre-teaching or learning, while teaching or learning and post-teaching or learning. They were discussed in detailed below:

6.1. Relaxed Alertness

Relaxed alertness is a state of mind, which meets the brain preference for challenge and meaning. William Purkey (1970) referred information as color-coded cards for brain in which color refers to emotional tone attached to incoming data. In belief, cognition and emotions cannot be separated. The studies in cognitive psychology and educational research understood how individuals deal with information to reorganize and enhance their knowledge. The learning process in our brain is similar to the process in computers where there is no role of emotions. Caine and Caine (1994) stated that emotions and thoughts interpenetrate and shape each other. Children could learn in their early life about what gives them pleasure and pain. The experiences always include the feelings. The terms like good and bad are individualized notions that inextricably mesh up the feelings and information and form into self. According to Marsh and Shavelson (1985), the self-concept theorists say that beliefs, biases, fears, reactions, predispositions, expectations, memories, knowledge, behavior, talent, and meanings together organize into a unique organized system, which is called self. Change in our understanding involves change in our self. They suggested that the new learning is the result of major interaction between cognition and self-perception, which cannot be separated from learning.

Csikszentkiralyi (1990) studied that sufficient relaxation boosts the power of an athlete in running competition so it is necessary for learners for peak performance. It is unlike being calm and unchanging and it is a state of the learners to be changed to dynamic compatibility. In the usual course of life the people have different degrees of interests, mood, curiosity, predispositions, and intensity of excitement which are influenced by many variables such as history of learner, social life, values and physiological changes in terms of blood pressure, respiration and hormone levels. It is said that the teachers have to keep creative tension among the learners with inclusion of comedy, drama, and music into the lessons. Doll calls it “dynamic tension”. Teachers need not be actors but they must enjoy the state of relaxed alertness most of the times with media to orchestrate lessons properly (Caine, 1994).

Cadance Pert (1999) conducted a study and unveiled mind-bending view of learning as real body-brain concept in her groundbreaking book “*Molecules of Emotion: Why You Feel the Way You Feel*”. She observed that the first category of “informative substances” to process learning is neurotransmitters that are responsible for synaptic leaps between the brain cells. The parallel system of second category “informative substances” includes peptides, hormones, and protein ligands. They travel through the blood stream and reach receptors on the outer surfaces of cells throughout the body. These molecules are the basic units of language used by cells

throughout the body and brain to communicate across systems like endocrine, neurological, gastro-intestinal and immune system. While travelling they inform, regulate, and synchronize. Peptides are the largest class of informative substance and every peptide, which is produced in the body, has receptors in the brain to be called "neuropeptide". With this process, it is understood that body talks back to brain, which alters and sends back to body. This theory gives rise to the idea of "body brain" which stands for constant collaboration between body and brain. For instance, when the student is at the end of put-down for his public error the body brain detects threat and triggers automatically to focus the attention more on the perceived threat than what teacher says and does.

LeDoux (1996) noticed how potential the threats to the safety or survival are detected unconsciously. Other conversations of body brain include "gut feeling" untrustworthy impression on someone, restlessness, understanding though unable to explain, passion for learning in particular field, love for beauty of nature, and the time spent with a special friend etc. An important discovery, which confirms the body brain conversation, is of the location where high concentration of receptors for information substance is found when input from our senses enters the nervous system. Cadance Pert called them nodal points or hot spots, which can be accessed and modulated by most of the neuropeptide that cause processing and prioritizing information. Thus, peptides filter input from our senses, select what is to be allowed in and significantly altering our understanding of reality. Pert says, "Emotions and bodily sensations are thus intricately intertwined, in a bidirectional network in which each can alter the other" (1999, p. 142). Antonio Damasio (1994, p. 164) emphasized, "Emotion is the highest part of our mind body survival kit". It guides the brain to what is worthy to attend and with which attitude one should attend. Robert Sylwester (1995, p. 72) says, "Emotions drive attention which drive learning, memory and just about everything else."

Kovalik (1997) found that Amygdala is an important part of the brain, which evaluates the emotional content in sensory input. When brain is triggered by the report of amygdala on threat, it overrides rational thought and orchestrates an instant reflexive response in the form of either fight or flight to assure survival. When the student is stopped by teacher and asked to take long breathing several times, the conversation between body and brain occurs informing the absence of danger. Thus, emotions are gatekeepers of learning. Therefore, a safe and predictable emotional climate starts with positive relations between teachers and learners. It is possible only when teachers know their likes and dislikes. When teachers, classmates, and administration take care of them personally, they thrive. Building team spirit activities (project based learning), clarity of procedures to do, building a sense of co-operative community (co-operative learning) and post agenda to give picture of what is coming every day, and teaching constructive ways to solve a problem (problem based learning) are necessary to keep the learners emotionally active to have the learning experience from the teachers' designs.

Wolfe (2010) noticed that the learning is important for our survival. The human brain efficiently pays attention to what is relevant to our daily life. It always enquires about "what is going on?" and "How is it important to me?" Robin Fogarty (1997, p. 36) reminded educators that a human brain is much like a sieve, letting go of much of the estimated 40,000 bits of information per second. The brain asks, "Does it make sense?" and "Do I care?" Unless input carries emotional and useful content, brain usually ignores it. Robert Sylwester (1995, p.96) says, "A memory is a neural representation of an object or event that occurs in a specific context, and emotionally important contexts can create powerful memories". Therefore, the absence of personal meaning and emotional hook, neural networks for long-term memories cannot be formed.

6.2. Orchestrated Immersion

John Dewey (1965) differentiated Knowledge and experience many years ago. The acquisition of knowledge is possible with process of experience. The job of the learners is to make sense from immersion of global experiences. Caine and Caine (1994) differentiated between orchestrated immersion, which offers rich and complex experiences along with a degree of excitement that empowers them to process information, pattern the options, sense of wholeness, and relaxed alertness, which offer a reasonable challenge in the context of safety to enhance focus on experiences including exploration of new thoughts and connections. Interest or preference of the learners enables them to interpret their work differently.

According to Caine and Caine (1994), orchestrated immersion is understood as thrusting information into the minds of the learners. It deals with how the content is introduced to the learners. The wholeness and interconnectedness enable the learners to employ their working memory system in the exploration of the content. Identification of various elements of experience and knowledge of how to bring them together effectively shall be the business of the teachers, which enables them to bring both practical skill and artistry together to be called orchestration. Hart (1983) suggested that the physical environment of the classrooms should be ten times richer than that of the classrooms now. Immersion in a field involves rich, complex, practical, and imaginative ways that ensure indispensible subsequent creative insight. Finding the ways or creating opportunities for the learners to have experiences, which are similar to complexity, challenge, and creativity of learners.

Caine and Caine (1994) considered orchestration as an approach to teaching, which unites planning and opportunity for spontaneity. Teacher involves the learners creatively in an experience, which is complex, meaningful and tags new bits of information to the natural pre-existing knowledge. Brain-based learning appreciates spontaneous creative teaching and introducing novelty in a way that enhances complex mapping. The teacher himself or herself becomes a part of his or her larger plan and design to orchestrate experiences for learners. Brooke Hindle defines "design" as it is the relation of things in space. So relating events, people, places, and objects in time and space is crucial to make orchestrated immersion successful. Donald Schon (1990) terms this as artistry and says:

- Inherent in the practice of the professional, recognize as unusually competent, is a core of artistry.
- Artistry is an exercise of intelligence, a kind of knowing, though different in crucial respects from our standard model of professional knowledge (p. 13).

Therefore, immersion is the assimilation of basic procedures and strategies and implementing them in a way that reveals personal artistry of the teachers. Cambourne (1988) stated that learning can be achieved with multiple complex and concrete experiences that enhance brains' optimal use. The meaning of optimal use of human brain is using brain's infinite capacity to make connections. Learners learn from their ongoing experiences. Knowledge of conditions that maximize this process is crucial. As the content cannot be separated from the context, educators must be expanding quantity and quality of the ways in which learner is exposed to content and context to acquire immersion. Harste (1989) studied that the more children talk about what they are doing, the more appropriate words of teacher, the greater the learning will be. According to Caine and Caine (1994), current teaching is based on the mistaken belief that reading and writing can be taught separately from meaning and purpose of the learning. Brain-based learning on the other hand rests on the fact that different disciplines related to each other share common information that the brain can recognize and organize. This is also called the heart of thematic teaching. Therefore, the educators have to orchestrate the experiences from which they can extract comprehension.

Marian Diamond (1985) conducted an experiment to study the impact of enriched environment on the brains of infant rats in a lab. The study suggested that the cortex of infant rats, which were caged with toys (experimental group), grew 7 to 11 percent thicker than the cortex of infant rats, which were caged with their mother and without toys (control group). It was found that new experiences change the brain physically. Brain cells that involved in cognition sprout new branches with increasing communication among neurons through the synaptic leaps. The physical mechanism of learning and memory is passing of electrical impulse between axon of one neuron and dendrites of other neurons. The repeated communication among neurons in neurons network make strong neural pathways then only it is possible to say that the people learnt something. Neuroscientists affirmed that the experience causes the growth of dendrites about which is said learning and observing as intelligence. The growth of dendrites can be measured with the growth in thickness of cortex where conscious thought takes place.

Simonds and Scheibel (1989) analyzed the brains of children who died between three and six years and observed that dendrite branching increased after the birth, as soon as sensory and motor experiences flood into baby's environment. Diamond and Hopson (1998: p.104) found that at "twenty-four months of age a child's frontal cortex is a true enchanted thicket of neural trees with busy dendrites and billions of shimmering spines". Kovalik (1997) concluded that these studies had implications for optimal learning. The experience serves as a

rich sensory input, which is far greater than the text and workbooks. First-hand experiences outside the school and real things inside the school evoke such rich sensory input to the brain. Visiting the places, inspecting the things from close, and observing the process of an event are experiences that enhance the neural networks. Moreover "being-there" experience gives additional power to input whether it is immersion, hands-on with real objects, hands-on with models, second hand or symbolic.

Caine and Caine (1994) suggested that knowledge of neural networks, which are crucial for human learning, depending on first-hand experience, contributes to orchestrate lively classroom with the real world. Brain research supports the process of engaging learners in talking, listening, reading, viewing, acting, and valuing. The best teacher teaches the learners more than teaching for the test. Such teachers encourage the learners to get deeper meanings and try to make the learners to have personal connections, which develop familiarity with a different vocabulary of society, and period in time. In the process, learners learn about themselves and life in experience. In this way, immersion in the subject involves linking information to their subjects, personal meaning, and expansion of vocabulary, history, and psychology.

6.3. Active Processing

Caine and Caine (1994) defined active processing as consolidating and internalizing information both conceptually coherent and personally meaningful to the learners. It is the way of understanding involving evaluation and assessment of experiences with the assistance of a skilled teacher through the activities; reflection, reflection on feedback, voluntary reflection, knowledge of deep meanings, contemplation and creative elaboration.

Caine and Caine (1994) suggested that a teacher should estimate how the learners apply their newly mastered knowledge and skills to improve their communities. The teacher has to improve the opportunities for learners with the association of new information, skills, and things which the learners care about to make a kind of meaning in long-term memory. The teacher has to attach the skill instruction to service projects like cleaning the stream, serving the community echo system in distress and take the learners to the playground for study that evokes the natural search of the learners for meaning by asking the question "So what?" It is contemplated that the precautions taken in choosing information, which is personally and emotionally, connected to student matter a lot. From this, an implication for the classroom can be drawn. A teacher has to know his or her learners through building personal relations with them. Then only the teacher can help them to discover those connections.

Caine and Caine (1990) stated that orchestrated immersion and relaxed alertness are not the whole story. Since learning brain is active, it draws a sense from every experience. It tests every experience against the existing knowledge. One of the responsibilities of educators is to enhance natural capacity of brain to recognize the pattern and make more connections. They have to work with the learners and assist them to discover maximum connections, deeper insights, and additional information, which are hidden in the experience through the activities such as questioning and reflection, consolidation and internalization of the data in the way personally meaningful to them.

7. Conclusion

Brain-based research gives implications not only to learning and teaching but also to the materials, administrations, and environment. It may be one of the best solutions to the chronic problems like attention, retention, and recalling of the learners. The adaption this approach will provide edutainment with experiential learning. Though it withstood the criticism for three decades, it still suffers, as it is quite common to any approach or method of learning and teaching. There are no clear answers to the questions about brain dominance, gender variation. As Thomas Alva Addison answered that, he did not fail but he knew 10,000 ways how the electric bulb works to the question how he felt when he failed 10,000 times. The optimistic educators go ahead to reframe again and gain their strategies for successful teaching. The implications from the successful discoveries in brain related disciplines ensure experiential learning in the context of relaxed alertness, orchestrated immersion, and active processing.

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