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The Brain and Developing the Ability for Learning, Linguistic Thinking, and Creativity - Towards Enhancing the Effectiveness of the Teaching and Learning Processes –

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Abstract:

The traditional classroom constrains our thinking strategies and limits our alternative responses. A teacher who insists on using a single teaching method and providing only one correct answer is, in fact, ignorant of the reasons that have preserved the renewal and evolution of the human species. Furthermore, he needs more academic ambition and to be made aware of the adaptive law within the human brain, where understanding the processes of learning and teaching requires knowledge of the brain's functions and operations. Simultaneously, he is trapped in thinking processes that rely on repetition and one specialization.

It is time to pursue what is new with students, seeking exploration, fluency of ideas, knowledge generation, and judgment thereon. This necessitates staying abreast of the latest developments in learning theories and searching for innovative educational approaches to enhance the processes of teaching and learning and create sound educational programs that foster creativity.

Keywords: Thinking, Learning, Development, Creativity.

Introduction:

Controlling higher cognitive processes leads to crafting a learner characterized by skill and mastery while motivating him to inquire, embrace exploration, and harness his potential for more profound learning. This motivation process is closely tied to attitudes toward learning and thinking, allowing for the distinction between a learner who engages in profound learning and thinking and a learner who adopts a surface-level approach to learning and thinking. The former perceives an event as a single occurrence processed from various perspectives, scrutinizing it from multiple angles driven by the desire for discovery, renewal, critique, and examination. In contrast, the latter views the event from only one perspective, implying that the former learns to observe matters deeply by controlling their cognitive processes and knowing when and how to employ them. At the same time, the latter deals more superficially, rushing to make judgments and decisions, lacking the ability for creativity and critique, thus becoming confined within rigid, dogmatic frameworks.

In light of this newfound understanding, novel meanings of learning can be presented. Rather than memorizing and storing knowledge, the focus shifts towards learning cognitive processes as a vital tool in learning. With this approach, students are guided to give fresh significance to their learning, empowering them to face real-life events with innovative and critical thinking. **Piaget** emphasized the importance of innovation in learning and teaching, supported by **Bruner**, who advocated for discovery-based learning, and **Ausubel** in meaning-based learning.

Through the proposition mentioned above, we consider the brain a complex system performing immensely intricate and challenging functions. It encompasses thousands of such systems, exhibiting remarkable flexibility in controlling information. Research concerning information processing affirms that any psychological activity, educational experience, or social relationship must inevitably transform into specific information stored and processed within the brain. Heredity may play a role in the plasticity of neural connections within the brain, which can cause its motion. Moreover, it could lead to the opposite of these characteristics, manifesting as rigidity and immobility.

Within known limits, it is acknowledged that learning, as a shared factor, stems from the specific educational environment. It must contribute to modifying these neural characteristics since it is evident that the distinction between the fool and the genius lies not in the type of mental activity itself but instead in the degree of mental activity. If we accept beforehand that there is a neurophysiological foundation for any psychological activity, we will conclude that this type of activity is uniform among all humans. Physiological, neurological, and biochemical data affirm the unity of biological neural activities in humans. Consequently, individual differences among people either lie in the type of trait or in the degree of its presence, which we determine through various scales reflecting the content of information systems derived from the external world **(verbal relationships, shapes, drawings, rapid performances, perception of spatial relationships in particular forms, numbers...).** The presence of individuals in diverse environments and the varied types of information they encounter, combined with how this information is conveyed, gives rise to internal transformations in the neural connections within the cerebral cortex. The field of electroencephalography elucidates the inherent nature of these profound changes in neural relationships, achieved through comprehending and interpreting the data obtained from the electrical mapping of the brain. After the scientists discovered different methods for recording the brain's electrical activity during various functional states, they devised a global map known as the (10% - 20%) system. This system uses precise distances with utmost accuracy to determine the diverse locations of the higher neural centers (Abdulwahab Kamel, 1994, p. 202).

Recording the brain's electrical activity relies on the premise that an electrical change occurs in the brain when an individual engages in any cognitive mental activity. The degree of this electrical change can be measured by determining the voltage difference between any two points on the scalp, depending on the type and purpose of the study. This voltage difference is measured in microvolts using the calibration key on the EEG device. The voltage difference indicates the magnitude of the wave obtained from spontaneous activity in the cerebral cortex. However, the wave's amplitude represents its energy quantity, necessitating another scale that illustrates the differences in activity among different brain parts, which is found in the frequency of the oscillations recorded by the device.

Based on this, the scientists raised the following problematic: **Do the parameters of the electrical activity of the cerebral cortex (E.E.G) change according to the type of mental activity practiced by the individual? Is it possible to teach students to discover and develop their educational methods through the optimal use of the two hemispheres of the brain through a double entrance in learning?**

The answer confirmed the occurrence of neurochemical and physiological changes in learning. Thus, education, in its objective and realistic sense, provides suitable environmental conditions to shape and employ neural cells in the brain, leading to behavioral regulation. Most research studies that explored the relationship between physiological evidence as measured by EEG brainwave patterns and human cognitive activity dynamics have affirmed this. One such study is **Hans Berger's** research in 1929, where he observed a decrease in alpha rhythm energy during the attention concentration process.

Travets and Egan concluded in 1938 that an increase in alpha rhythm frequency among individuals during silent reading. Similarly, Backman and Chitein found in 1961 a strong correlation between the percentage of alpha activity and performance levels in non-arithmetic tasks.

In an attempt to directly reveal the correlation between cognitive processes and brain activity, **Michael Bosner**, **Stephen Peterson**, and their colleagues at the McConnell Center for Higher Brain Functions at the University of Washington conducted a series of essential experiments related to word processing in a normal healthy human brain, using the positron emission tomography (PET) axial scanning technique and using Scanners. It turned out that the posterior visual cortex region of the cortex reacted when looking at the word on the screen, and the middle part reacted when hearing the word. Also, the association area produced the most significant amount of activity. The general activity could also be observed in all cortex areas (Solso, 1996, p. 81).

The current availability of modern tools has led to an accelerated and more precise understanding of the brain. Among these tools and devices are the Computerized Axial Tomography (C.A.T), the Positron Emission Tomography with X-rays (P.E.T), Magnetic Resonance Imaging Techniques (M.R.I), and other tools.

The preceding demonstrates that a neurophysiological basis governs cognitive activity through observing qualitative changes in the brain's electrical activity that accompany specific mental tasks. This reaffirms the necessity of providing opportunities for information that allows for self-regulation of behavior. Neurophysiological data is utilized as indicators of cognitive activity, aiding in understanding the language of the brain and its nature. Consequently, insights are gained into how neural cells are enlisted and employed to attain cognitive behavioral qualities.

Bold research endeavors have also answered some inquiries concerning the brain's capacity to receive and transmit information as signals of its functional state. This underscores the crucial role of teaching methods and the educational system as the fundamental axis shaping, modifying, and utilizing those neural cells that emit signals indicating the information they carry. Hence, understanding the mysteries of the brain, where neural cells play various roles, becomes of utmost significance in learning.

In fact, didactics is a constantly evolving science, built on other sciences that are also advancing and sharing with the student and the instructor, including linguistics, behavioral and cognitive psychology, neuroscience, and artificial intelligence at the forefront. Every new development in the research of the previous sciences benefits didactics, deriving from it what enhances the learner's performance. This sustains the investment in the achievements of supportive sciences, keeping them alive and evolving to serve teaching and learning.

- ✓ **How can we benefit from the findings and achievements of neuroscience for didactics purposes?**
- ✓ **What is the relationship between the brain and the development of thinking, learning, and creativity, and how does it enhance their effectiveness?**
- ✓ **What are the characteristics of brain-based learning?**

1- The brain and learning: The brain is a pivotal organ in psychological activity, responsible for processing information and making decisions, thus playing a crucial role in the learning process. To elucidate the brain's role in learning, **Asratian** published a book entitled "**The Learning Brain**" in 1983, focusing on the neural mechanisms of learning and memory and the relationship between brain function disorders and their impact on the learning process. As learning is associated with sensory and motor pathways, any behaviour involves sensory and motor processes at the neurological and physiological levels. Sensation constitutes the seeds of sensory perception, which, in turn, leads to cognitive perception, imagination, and thinking. The foundation always lies in the senses and higher centres, executing motor commands, where the brain realizes sensory **information saturation**, followed by the representation of informative structures and cognitive mental capacities participating in recognition of new sensory information (Abdulwahab Kamel, 1994, p.127).

The simple analysis reveals that learning difficulties stem from three sources:
A- Sensory disability or the senses not functioning as they should.

B- The senses may be intact, but there could be injury or damage to higher neural centers.
C- In some cases, learning difficulties arise due to the inability to execute brain commands through the motor nervous system. For example, some individuals may be capable of hearing and understanding language sounds but unable to write or reproduce visual or auditory letters. Cases of motor impairment exemplify this scenario.

These difficulties highlight the profound relationship between the brain and learning. They demonstrate that addressing these challenges begins with identifying the type and degree of difficulty, enabling the determination of therapeutic intervention methods, whether in the family or at school. **Pavlov's** works, mainly through his application of the scientific and objective method in studying the refined neural activity and uncovering some fundamental secrets of the brain's functioning, notably the conditioned reflex, serve as the foundation for the equilibrium between the organism and the environment, and consequently, for learning **(I. Pavlov, 1963).**

In his interpretation, **E. Thorndike** explained the relationship between the brain and learning by giving a theory based on physiological knowledge. He considered learning as a process of neural facilitation across nerve pathways, followed by physiological changes linked with the occurrence of learning, rather than the development of entirely new neural connections.

Lauria (1973) identified three functional units of brain operation. One of these units is dedicated to regulating cerebral energy to reach an optimal level for processing information in the higher centers. The functions of this unit primarily derive from network formations. Consequently, conscious and organized learning must occur at optimal alertness and attention or activation. The teacher must be fully aware of the means to activate the brain to the required optimum level, because some learning difficulties may arise due to attention distraction. Therefore, the role of **audiovisual media** comes into play in preparing the brain to receive information during the learning process.

On the other hand, **L. Dubé** (1990) clarifies the fundamental foundations of learning as that unique ability of the nervous system. He emphasizes that the brain serves as the tool of human behavior and, consequently, of learning. This truth has been firmly established since 1850, leaving no room for doubt regarding the brain's pivotal role in learning **(Dubé, 1990, p. 241**).

2- The Two Hemispheres of The Brain and The Development of Thinking and Creativity

The brain is divided into two similar components: the right and left cerebral hemispheres, which form the most significant part of the brain (about nine-tenths) covered by the cerebral cortex. Between them lies a central depression that extends to a considerable depth but does not entirely separate them.

The cerebral cortex and the two cerebral hemispheres constitute the organ of higher neural activity. The cerebral cortex is a crucial determinant of mental activity, as it houses higher centers responsible for psychological and qualitative functions that shape human behavior. The cerebral hemispheres contain sensory centers, which consist of clusters of nerve cells that receive corresponding sensory nerve fibers.

The brain processes information contralaterally, meaning that sensory information received from the spinal cord, such as tactile sensation, which entered the left side of the body, is initially processed in the spinal cord and then sent to the right side of the brain for final processing. The motor centers in each cerebral hemisphere control movements executed on the opposite side of the body (Williams, 1997, p. 31).

Modern neuroscience experiments confirm that the cerebral hemispheres' most significant feature can be metaphorically termed the "Bicameral Mind." Each brain hemisphere possesses a distinctive cognitive perception characterized by its programming system and informational content. It is as if each cerebral hemisphere captures the external world according to its unique cognitive perception pattern (Abdel-Wahab Kamil, 1994, p. 160).

Some specialized studies also demonstrate the qualitative functional specialization of the cerebral hemispheres. One of the earliest works in this regard was conducted by the French neuroscientist **Paul Broca** in 1861 when he studied language disorders known as "Aphasia," which causes difficulties in speech for patients. He discovered that the principle governing the coordination of the body does not apply to the brain's functions. Patients with brain damage in the left cerebral hemisphere suffered from slow and abnormal speech patterns, while the same damage in the right hemisphere did not lead to speech difficulties (Solso, 1996, p. 205).

Neuroscientist Franz Wernicke (1876) emphasized that specific mental functions have designated centers in the brain, but these centers are associated with simple perceptual and motor activities. However, complex mental processes such as **thinking, memory, and comprehension** result from interactions between perceptual and motor areas. Spanish neuroscientist **Santiago Ramon y Cajal** also agrees with the functional specialization of the cerebral hemispheres.

Another clinical evidence of the brain's opposing activity and functional asymmetry emerged when neurosurgeons treated patients with severe epilepsy by cutting the corpus callosum. This structure connects the two cerebral hemispheres to identify the negative effects of epileptic seizures on the activity of each hemisphere of the brain.

The research conducted by **R. Spery** (1962) aimed to identify the impact of decerebration on different functions associated with each cerebral hemisphere. **Spery** collaborated with **Mayers or Michael Gazaniga** to study the functional inconsistency between the two cerebral hemispheres after the decerebration procedure. The patients who underwent this procedure appeared to have two separate brains, each capable of perception, focus, learning, and memory independently from the other. Interestingly, when a familiar object was placed in their right hand, like a coin or comb, they could describe it verbally because the information crossed from the right to the left side, where the language processing center is located. However, when given the same object in their left hand, they struggled to describe or articulate it verbally.

Nonetheless, they could point to the object only using their left hand (Solso, 1996). Although our understanding of the purpose of decerebration in the two cerebral hemispheres remains shallow, the results have contributed to crystallizing the theory of functional specialization. It has become evident that each cerebral hemisphere carries out distinct functions uniquely. A wealth of popular scientific ideas exists among the general public regarding the functions of the two cerebral hemispheres. Some people assume that **contemplation** in Easterners and **rationality** in Westerners are associated with the right and left cerebral hemispheres, respectively.

According to **Ornstein**, Western societies prioritize logical thinking, reading, and verbal information processing. In contrast, other cultures, especially Eastern ones, are more concerned with a different form of consciousness based on intuition and insight (Solso, 1996, p. 106).
Additionally, various studies have provided a clear understanding of Hemisphere Specification as a cognitive pattern. Below is a concise description of this phenomenon:

2-1- Left Cerebral Hemisphere

The hemisphere, known as the dominant or controlling hemisphere, is responsible for analytical functions, linguistic abilities, and consecutive cognitive processes like writing, language, and speech. It uses a digital cognitive pattern because information received by the left hemisphere is encoded in a way that is similar to digital logic. The left hemisphere is also involved in logical reasoning and rational functions, making it well-suited for making logical decisions that ensure survival. Research conducted by **Spery, Gazaniga, Bogen** (1965), and others has confirmed that the left cerebral hemisphere is associated with specific cognitive functions, such as language, conceptualization, analysis, and classification. A linear and sequential manner characterizes information processing at this level.

2-2- Right Cerebral Hemisphere

It is referred to as the non-dominant hemisphere, primarily responsible for synthetic and **creative** functions. Unlike the left hemisphere, it relies on analogical simulation in the form of physical quantities, which uses digital information processing.
The right hemisphere is characterized by a pattern of holistic scanning and an intuitive influence, and it is also associated with non-verbal performance, image-making, and musical patterns. It is connected to functions involving information integration over time, as seen in literature, music, spatial processing, and facial and spatial recognition. For instance, it allows us to

navigate a city and locate specific places, streets, or addresses. (Giordon, 1998, p 57).

The most important feature distinguishing information processing at this level is that it occurs in a holistic, aggregative, and heuristic manner.

From the above, it can be inferred that the brain does not simply work by establishing links between its parts, as traditional theories assume. Instead, it operates more collectively and intricately, guided by distinct rhythms of neural activities. These rhythms are driven by cells in specific regions and are contributed to by countless cells distributed throughout the brain.

This conclusion leads to the assumption that a certain number of functions are distributed across most cerebral regions. However, specific areas serve certain cognitive functions more crucially. For instance, the motor cortex (The motor area in the brain) plays a central role in movement, while the visual cortex is vital for visual perception. Thus, cerebral processing is dissipated throughout the other regions of the brain. The brain functions as an integrated whole, even when each hemisphere specializes in specific functions.

Based on the previous, it is possible to consider the interplay of both cerebral hemispheres in a more comprehensive context. This, in turn, necessitates further scientific research to explore the encoding system employed by each cerebral hemisphere and the importance of paying greater attention to the integrated function of each.

Most educational practices within most educational systems worldwide tend to encourage and stimulate the activity of the brain's left hemisphere, i.e., the dominant hemisphere, at the expense of the right hemisphere. The higher percentage of people who write and perform most of their tasks using their right hand is a clear testament to this (Ali Al-Deeb, 1996, p. 203). Consequently, the intelligence quotient (IQ), which essentially represents the ratio of the left hemisphere's abilities to that of the right, becomes a misleading measure and concept in education, depending on age. This ratio reflects the results obtained from the left hemisphere's dominance in the methods it employs. Unfortunately, most educational systems still select learners based on this ratio, leading to a bias towards the left hemisphere. Learners are placed in educational situations that stimulate the activity of the left hemisphere, and their responses are reinforced accordingly to benefit from utilizing this hemisphere and then function in society as expected. It is as though they do not have access to the benefits of a right hemisphere that could have been utilized.

As for the learners who do not achieve high degrees in the **intelligence** quotient, it may be due to a general deficiency in the cerebral cortex's ability to process information or the inefficiency of their left hemisphere, while their right hemisphere remains fully functional and capable of being engaged when stimulated with relevant content. That they have been exposed to through education and upbringing did not allow them to activate and utilize the information with both cerebral hemispheres, leading to lower test results. The final consequence of this unnatural selection is the loss of human potential and capabilities, resulting in wasted human energy and missing out on the opportunity to harness the human brain's miraculous construction.

Firas Al-Saliti (2008, 113, 123) states "We possess a brain with boundless potential, and it is disgraceful to treat it merely as a transportation vehicle. The brain's paramount function is **thinking and problem-solving**." He also mentions that the unconscious mind acts before the conscious mind, as two seconds before the actual movement of learning, the brain has already predetermined which body parts to activate and which hemisphere to utilize. This implies that you are acting and reacting before you even realize it, and thus, most of what is learned occurs unconsciously.

3- Pedagogical implications

The theories of brain activity and the specialization theory of the two hemispheres have led to numerous educational implications, including what is now known as cognitive styles. Two distinct and integrated cognitive styles have been identified for receiving and processing information. The left hemisphere processes information linearly and analytically, governing words and language, while the right hemisphere processes information holistically and spatially, controlling images and structures. Consequently, each individual has a preferred or dominant cognitive style based on their personality. This means they may prefer to use the left hemisphere more than the right, or vice versa, in their learning and processing (B. Chevalier, 1993, p. 25). This distinction has led to the proposal of diverse teaching strategies to address these stylistic differences, which are closely linked to the channels of information reception.

In addition to the educational implications related to cognitive styles and the proposed techniques for enhancing learning, there are other techniques based on theories of brain activity and the specialization theory of the two hemispheres. One such technique is "Brainstorming,"

Brainstorming technique

The term consists of two English words: "Brain," which means the organ of the central nervous system, and "Storming," refers to whirlwind or storm. This term has been translated into Arabic using various synonyms, including: "Istimtār al-Damāgh" (Brain Storming), "Tadfuk al-Afkār" (Flow of Ideas), "Tawlīd al-Afkār" (Generation of Ideas), "Zūbahhah fī al-Ra's" (Whirlwind in the Mind), "Anfjār fī al-Takhayyul" (Explosion of Imagination), "Hujūm al-Afkār" (Onslaught of Ideas), "Al-'Aṣf al-Dhahni" (Mental Storming), and regardless of the different meanings, they all convey the core idea of breaking free from the constraints of imagination and allowing it to produce ideas spontaneously and creatively (Basagana, 1983, p. 248).

Alex Osborn, renowned as a progenitor of this technique, first conceived its principles and governing rules in his seminal work 'Applied Imagination.' He expounded on its potential application across diverse domains, such as industry, administration, and education. In a resolute demonstration of his convictions, he established an institution for innovative education in 1954, wherein this technique found practical implementation. Subsequently, in 1963, he inaugurated the pioneering institute for innovative problem-solving.

Later, Parnes, following in Osborn's footsteps, tirelessly endeavored to refine this technique and lay its theoretical foundations. After that, research endeavors and scholarly investigations ensued, devoted to fostering critical and innovative thinking (Amal Al-Ahmad, 2001, p. 146).

Alex Osborn defined *brainstorming* as a form of organized ideation, where mental images are generated orderly, in contrast to what is known as idea formation (A. Barker, 1999, p. 22). It also represents a creative gathering tailored to produce a list of ideas that can serve as keys to unlock the crystallization of a problem and lead to its resolution. It relies on uninhibited collective thinking, open to reality, not shrouded in embarrassment, and unhampered by rigidity or inertia (Osborn, 1963, cited in Amal Al-Ahmad, 2001, p. 148). Furthermore, it constitutes a collective endeavor that provides an opportunity for elucidating and exchanging ideas among members of a unified group. The idea put forth by the first individual acts as the spark from which subsequent ideas emanate from others. Each idea begets another until an immense multitude of ideas is amassed, all aimed at resolving the posed problem on the canvas of exploration. In this manner, brainstorming becomes a collective and organized thinking process governed by defined steps, procedures, and clear objectives.

This technique is based on four fundamental principles:

1- Everyone can generate ideas.

2- Without judgment, all ideas can be considered valid in the initial phase.

3- No criticism is allowed in the first stage.

4- Each individual should allow his ideas to flow freely and refrain from imposing any constraints on them (Barker, 1999, pp. 16-17).

According to this technique, the process is achieved as follows:

Step One: Productivity - Each individual produces the most significant possible number of ideas on the subject under discussion or consideration, according the defined principles.

Step Two: Categorization - During this step, the generated ideas are collected based on specific criteria without concern for their value.

Step Three: Evaluation - In this phase, the produced ideas are subjected to criticism, and the criteria for evaluation can be chosen based on the ideas' realism or originality, depending on the nature of the task.

Step Four: Recording of Ideas and Presentation of Solutions - During this step, ideas that receive a degree of consensus according to the predefined criteria are retained.

The most effective ways of meaningful learning are studying real-life problems under real conditions, attempting to relate new information to meaning in life, brainstorming and teamwork, and being assigned complex projects with experienced assistance are the best ways. Brain chemistry changes based on an enriching learning environment with positive stimuli, which greatly helps support students and encourage positive relationships between them, allows them to express themselves, and increases their sense of safety and security at school.

The human brain is influenced by those interacting with it, and the individuals surrounding it are integral to a larger social system. The brain begins to undergo influence upon reception and response to its environment. Researchers have meticulously recorded cerebral changes in children through their early interaction with the social environment. For instance, a parent's smile (the simplest of things) impacts a child's brain function (Douqan Abidat, Souhila Abu al-Samid, 2007, p. 3).

The brainstorming strategy is the most widely used strategy for developing thinking in general and creative thinking in particular through an educational context that enables the student to generate a greater number of ideas and problem-solving situations within an atmosphere of freedom and security, away from criticism. The juxtaposition of perspectives imparts a social hue to the cognitive conflict, subsequently evolving into a catalyst for interactions and cognitive expansion.

In the realm of cognitive and social conflict, there exist two types of conflicts: inter-individual conflict, which is social between individuals, and intra-individual, which refers to a cognitive conflict that coincides with the awareness of the learning self (contradictory answers, doubt in the response, etc.). The social dimension of cognitive conflict is fundamental, as the direct expression and confrontation of evidence in interactions render the intra-individual cognitive conflict more realistic and dynamic. In other words, this cognitive conflict creates an imbalance within the individual, motivating him to overcome it. Besides, A possible way to facilitate finding a standard solution to this conflict is by resolving individual differences (Contemporary Educational Theories, p. 172).

Conclusion:

This article aims to enable learners to discover and develop their learning methods and to optimally utilize the two hemispheres of the brain through an integrated dual approach to learning by understanding the mechanisms of brain function. This allows the teacher to fully play his role as a trainer and catalyst, to identify and diversify his pedagogical intervention style, and to interact with the learner through more effective communication. On the other hand, it allows the student to be more capable of discovering his strategies for success and failure and to develop other strategies beyond those they were often confined to. Furthermore, it broadens his cognitive scope and enables him to collaborate with himself (Co-author of oneself).

In general, the results of the article can be summarized in the following points:

1. Brain functioning theories-derived techniques help students better understand and apply their skills by diversifying learning sources and optimally applying the capabilities of both brain hemispheres in an integrated manner.
2. Developing students' skill in thinking tools helps them strive for success in challenging tasks, positively impacting their academic achievement and enhancing the quality of their lives.
3. The competence and proficiency of learners are not merely a result of their age advancement, nor are they incidental or secondary outcomes of a teaching process that heavily emphasizes subject matter and rote memorization. Instead, they result from training and practice facilitated by effective strategies and programs.
4. Brain-based learning impacts self-esteem, achievement motivation, attention improvement, and academic ambition.

Finally, this article provides a conceptual framework for a common language among specialists in cognitive psychology, neuroscience, neurology, education, and artificial intelligence.

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