

# Is Neurocognition Crucial in STEM Education in the Present Scenario?

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## 1. Abstract

Countries around the globe moving away from traditional rote and regurgitation learning to experiential learning. Science, Technology, Engineering and Mathematics are the subjects interlinked with each other. Most of the countries in the world prefer to adopt STEM (Science, Technology, Engineering, and Mathematics) education because it infuses every part of our lives. Without Science and Technology our survival in this globe is questioned. Technology is constantly escalating into every aspect of our lives. Engineering is the basic subject for designing the houses, machineries, construction etc. Basically everyone need Mathematics in every occupation and every activity of lives. STEM based curriculum comprise of hands-on and minds-on activities for the student. By divulging students to explore STEM-related concepts, they will develop a passion towards it. Nevertheless of voluminous initiatives by all the countries, are on the way to impart STEM education to students due to their difference in perception, knowledge and memory. Neurocognition is the process which activates the cognitive process. Depending on the needs of the individual Neurocognitive strategies will restructure or modify their thought, feelings, perceptions and emotions. This article addresses the theoretical back drop of Neurocognition in education and how the issues related to educational performance can be solved with the help of Neurocognitive practice.

**2. Keywords:** Science, Technology, Engineering, Mathematics, (STEM) Brain, Neurocognition

## 3. Introduction

In the 21st century, scientific and technological innovations have become progressively important to encounter the challenges of both globalization and knowledge-based economy. To succeed in the technological society, students need to develop their capabilities in STEM to the intensities beyond the past [1]. Ultimate aim of our education is to fetch a decent job in the future. The global economy is changing. Due to technological advancement current manpower based jobs are disappearing due to automation and new jobs are emerging every day. Nowadays classroom teaching

remains much teacher-centred, whereas learners are blamed for lacking talent and are deprived of the right to develop themselves [2].

#### **4. Status of STEM skills towards job market**

Advances in technology are altering the mode students learn, connect and interact with people every day. STEM offer them with the foundation to succeed beyond their formal education. Present education system is not generating enough STEM accomplished students to keep up with the demand in traditional STEM occupations and other sectors across the economy that claim similar competencies [3]. Employer demand for STEM skills is high, and will increase in the future. Currently, 75 per cent of jobs in the fastest growing industries require workers with STEM skills. Australian workforce needs people to be competitive enough to adapt the changing workplace. STEM empowers individuals with the skills to succeed and adapt to this changing world. [4]. Augustine specified few reasons to improve STEM education in United States. Though they like to think of America as being first in everything but in reality it ranks 6th among developed nations in innovation-based competitiveness, 11th in percentage of young adults who have graduated from high school, 15th in science literacy among top students, and 28th in mathematics literacy among top students [5]. Despite of America's initiatives like The STEM Education Coalition and The American Competitiveness initiative is in vein to develop all students are literate enough in STEM to become excellent contributors to society [6]. Globalization and the expeditious development of ICT are transforming society in consequent to meet the demands of 21st century workplaces [7] STEM education is necessary to facilitate economic development, international competitiveness and job creation [8].

#### **5. Scope of STEM education**

To be proficient in 21st century skills or STEM skills one need to possess the attributes like creativity [9], critical thinking [10], problem solving [11], communication [12] and digital literacy [13]. STEM educational initiative is to provide all students with critical thinking skills that would make them creative problem solvers and ultimately more marketable in the workforce [14]. Main aim of STEM education programs is to prepare today's children to become innovators and inventors of tomorrow. Despite of ample opportunity given to students, could not achieve the expected results since the individual differences prevails among students due to the dissimilarity in the knowledge, skill and attitude.

#### **6. Contributions of brain in developing STEM skills**

Naturally the learning process depends upon the activation of brain. It functions based on the processes input, storage and output. Human brain is highly plastic and adopt to gain any new experiences. Brain plasticity varies from children to adult. Altered brain activation in limbic and/or front parietal regions [15], [16] has great potential for tailoring optimal learning situations for long-term meditation. The stimuli received through the sense organs will be processed

in the brain like information processing, restoration and retrieval. Neurocognition does the function of perceiving, recognizing, conceiving, judging and reasoning processes. Neurocognitive learning theory is a synthesis of three components of inquiry such as (i) neurophysiology with an emphasis on the biological bases of brain and neural activity (ii) cognitive science focuses on information processing and the internal presentation of experience, and (iii) learning theory that explicates how we cumulatively interact with, and adapt to, our environment [17].

[18] Revealed that integrating neuroscience, cognitive science and constructivist perspectives into science and mathematics learning had a noteworthy impact in the learning achievement of students. Apart from critical thinking and problem solving, leadership, decision making and strategic planning are important skills required for an engineer. Neurocognitive based teaching model is recommended to Thailand Ministry of Education since it contributes to positive performance of students [19].

Human brain is designed to be creative which is divided into left and right cerebral hemispheres. Although the macrostructure of the two hemispheres appears to be almost identical, different composition of neuronal networks permits different functions in each hemisphere [20]. Each hemisphere has an outer layer of grey matter called cerebral cortex and an inner layer of white matter. Grey Matter is a major component of the central nervous system is made up of about 86 billion neurons while the white matter is made of dendrites and axons that the neurons use to transmit signals [21].

Neurons do complex mental processes every second, and regulate our sensations, perceptions, reasoning, thinking, emotions, mental images, attention span, learning, and memory with its pattern of connections between neurons [22]. Broca's and Wernicke's areas in the left hemisphere contributes to language development and exclusively does the functions such as semantics, intonation, accentuation, and prosody [23]. The frontal lobe is responsible for higher order cognitive skills like problem solving, thinking, planning, and organizing [24]. Parietal lobe is involved with sensory processes, attention, and language. Occipital lobe helps in processing visual information [25]. Temporal lobe has a role to play in short-term memory through its hippocampal formation [26]. Emotional responses are done through amygdala [27].

Human brain makes hundreds of new neurons everyday throughout the life in the hippocampus which is responsible for memory. There are two types of memory, declarative memory primarily involving hippocampus and procedural memory is for skills and other cognitive operations [28]. Synaptic Pruning is a function of the brain that helps to minimize the number of connections to a specific memory in order to make that memory more efficient [29]. Decay theory proposes that memory diminishes due to lack of knowledge and information, lack of recalling, lack of rest, lack of sleep and lack of healthy food and nutrition can have negative effects on the brain power [30].

Brain is a machine that needs overhauling. Neuron connections in the brain become weaker when we stop using them [31]. Maintaining skills and abilities at a proficient level needs exercise. Human use 10% of their Brain [32] may be

the reason for failing education system. MRI's show that only certain areas of the brain show activity during certain actions. Joe Herbert's lab in Cambridge has revealed that cortisol produced due to stress dramatically decreases the production of new brain cells. Brain exercises, memory training [33] and mindfulness meditation [34] do alterations in the brain during learning which in turn improves cognition and helps people perform better on things like planning, scheduling, multitasking and working memory since it makes the nerve cells more efficient or powerful [35].

## 7. Neurocognitive Training or practice

Learning is a multidimensional process that creates a changed state [36] and concomitant change in the activity of the brain. Neurocognitive training is a strategy to train the brain to perform cognitive tasks [37] like attention, concentration, short-term and long-term memory seamlessly. Students find difficulties in the executive functions such as organization, planning, prioritizing, time management, behaviour/emotional control. Neurocognitive training is a complete solution which covers up and enables the brain how to focus, concentrate and pay attention not only to the interesting things but also to the needy things with enduring effect. Neurocognition has tectonic change over learning process. Neurocognitive based mindfulness training has a positive impact on attention processing of students [38]. Individuals with numerous forms of disability in learning and other neurodevelopmental disorder may require quite diverse parameters of training in order to foster brain plasticity effects [39].

## 8. Conclusion

Science is more than a school subject, or the periodic table, or the properties of waves. It is an approach to the world, a critical way to understand and explore and engage with the world, and then have the capacity to change that world said by President Obama. No child left behind (NCLB) is the federal law of America. Neurocognition will provide myriad of choices in the learning process. Goal of immediacy is possible through neurocognitive training. It gives impetus to the learners to learn with commitment. Neurocognitive training equips students for the classroom of tomorrow. One should understand how individuation and motility might be realized in the classroom practice. A classroom full of learners with the same age group does not mean they are ready to learn a particular topic, idea, concepts and skills uniformly. Neurocognitive training will help us to reach the unreached which is an irrefutable fact of the brain. A key philosophy was to make the school fit the child instead of making the child fit the school. Neurocognitive training takes cognizance of the individual understanding, perception, processing of information and restructures the brain to achieve what it intends to achieve. By adopting this strategy in teaching process STEM education is possible without any adversity.

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