Using Cognitive Neuroscience Research Findings in Designing Pedagogical Tools for Adolescent Learners

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Abstract- *To ensure desired learning outcomes, a lot is being done in the areas of developing better curriculum, making state of the art schools, improving teacher quality, incorporating ICT, enhancing parental involvement etc. However, when it comes to designing Pedagogical Tools based on the learning patterns of the brain, there exists a wide gap between what is researched in laboratories and what is experienced in our classrooms. Pedagogical practices not based on an understanding of brain's functioning can lead to Cognitive Overload in learners causing undesired behavioural consequences in them, especially in Adolescent Learners. This paper looks into various researches that have been done in Cognitive Neuroscience and their educational implications on Adolescent Learners. This paper suggests that pedagogical practices must create a learning environment that utilizes brain's pattern of learning. It explores why Teacher Training must include training Student Teachers in cognitive aspects of an adolescent's brain like role of reward system, enhancing Working Memory, providing multisensory stimulus to learners, using memory strategies, understanding learning loops etc. This paper concludes how learnings from these Cognitive Neuroscience researches can address the issue of High Riskbehaviour tendencies amongst adolescent learners.*

Keywords: Cognitive Neuroscience Research, Pedagogical Tools, Adolescent High RiskBehaviour, Adolescent Brain, Working Memory

Introduction

In the changing society, education is changing at a rapid pace too. The policy frameworks are made to ensure that education lays a foundation of an empowered life for each learner. Learning environment is now equipped with technological support and various breakthrough pedagogies are developed keeping in mind the desired learning outcomes. To keep pace with changing school learning environment and its demands, Teacher Education programs are also revamped from time to time. However, while designing educational programs and breakthrough pedagogies, little attention is paid to linking them with learning styles of a learner's brain. This becomes a greater challenge as the learner's grow in age. Stepping into adolescence brings along major changes in brain and its functioning. This often leads to a greater mismatch between pedagogical styles and learning patterns of an adolescent learner's brain. Extensive Cognitive Neuroscience research has happened in the last few decades to

understand how human brain works. Unfortunately the findings of these researches have hardly seen their way from laboratories into the classrooms. Though the primary aim of education should be to help students effectively utilize the vast capacity of their brain, education narrows down the brain's utilization to tasks involving academic achievement. Irrelevant teaching practices can lead to cognitive overload in learners causing undesired behavioural consequences in them, especially in adolescent learners leading to High Risk Behavior tendencies in them.

This paper, through various articles on brain-based researches and secondary data, attempts to look into the learning styles of an Adolescent Learner's brain and its implications on education. It emphasizes on the fact that it is important to understand the working of human brain before designing pedagogy. It also suggests various steps that can be taken in this direction.

Methodology

This paper is a study based on secondary data from various research articles in journals and websites and books on Cognitive Neuroscience research and Adolescent behavior and their educational implications.

Human Brain

Information is gathered by brain through Working Memory which is a psychological space of limited memory that can hold limited information at one time. Working Memory sends information to long term memory of infinite capacity in brain capacity for later retrieval. Working Memory causes the activation of Prefrontal Cortex in brain, which is responsible for reasoning, judgment, setting goals, analysis of consequences and other cognitive functions.

Adolescent Brain

During the period of adolescence, the Prefrontal Cortex of brain is still in developmental stage and is not fully developed before early twenties. The Limbic system, a neural system in brain activated by reward, avoidance and emotions, is fully developed and takes precedence over other pathways of information processing in case of Prefrontal Cortex shutdown. Owing to these characteristics, adolescents have high emotionality, high reward sensitivity and intolerance to cognitive overload.

Cognitive Neuroscience Research

A lot has opened up in cognitive neuroscience due to extensive research happening in this area. Major breakthroughs have come in understanding Working Memory, which is a psychological space of limited memory with an ability to hold limited information at one time. It is basically responsible for telling us what we do with what we know. Any information through our sensory perception goes into Working Memory which is then sent to long-term memory of unlimited capacity for later retrieval. Working Memory capacity is different for different individuals. It also has different learning loops for visual, auditory and verbal material. A large Working Memory gives a learner an advantage in learning and assessment. It helps in development of certain memory strategies that result in coding information for sending it into long term memory and later retrieving from it. A large

Working Memory enables an individual to device more creative memory strategies. Conditions like stress, information overload, too much information to process, lack of previous knowledge linkages in instruction, following too many instructions, completing complex tasks, lead to what is known as Cognitive Overload and cause reduction in Working Memory capacity. This leads to lowering and eventually shutting down of Prefrontal Cortex functioning.

Impact of shutting down of Prefrontal Cortex on Adolescent Learners:
As the Prefrontal Cortex shuts down due to above mentioned reasons, one or more of following conditions are likely to arise-

- Activation of Limbic Reward System
- Increased attention to perceived threat
- Academic underachievement
- Reduced attention span
- Getting distracted
- Having less control over impulsivity
- Inability to deal with social and academic tasks
- Having problems with monitoring the quality of one's own work
- Inability to evaluate consequences of decisions
- Increased anxiety
- Social, emotional and behavioural difficulties

In light of these challanges the chances of adolescents' indulging in High Risk Behaviour like risky sexual behaviour, substance use disorder, violent behaviour, and increase manifold.

Suggestions
In view of above presented facts, following suggestion can be considered for educational purposes:

- Including certain Games and Activities that don't just make tasks fun but help students handle complex information while feeling rewarded, can be used as pedagogical tools.
- Since Working Memory can hold more information through various learning loops like visual, verbal and auditory, a teacher can present information through multiple channels for better understanding and clarity.
- Students when engaged in activities that stop negative thoughts from entering their minds show increase in Working Memory so classroom environment should be free of negativities.
- Working Memory training has been largely done in labs or for trial purposes but no regular classroom practice for training Working Memory exists. Areas to enhance students' Working Memory in schools can be explored.
- Exercises like Recalling information, Memory games, Strategy building games, Visual memory games, Chess, picking out relevant information from random texts

etc. are known to increase Working Memory. Hence, these can be linked to curricular material and included as Pedagogical tools.

- Teacher scan device memory strategies to help cope those learners who have low Working Memory.
- Since each individual has a different Working Memory capacity, not all children need these exercises and therefore 'one size fits all' approach should not be used. These exercises should be need based.
- A basic understanding of a learner's brain and its cognitive aspects like the role of reward system, enhancing Working Memory, providing multisensory stimulus to learners, using memory strategies, understanding learning loops etc. should be included as a topic in Teacher Training curriculum.

Conclusion

It can be concluded that the significance of understanding the brain of a learner cannot be ignored while designing Pedagogical tools. A true learner-centric approach needs to be based on an understanding of cognitive aspects of a learner's brain. In absence of such an understanding and lack of brain research based instructional processes, the desired learning outcomes cannot be fully achieved. It is also very important that adolescent learners who are at a critical phase of physical, mental, emotional and physiological changes are presented with the academic content in a manner that does not increase stress, impulsivity and the feeling of fear in them. Such practices can help reduce instances of social and behavioural difficulties in adolescents and prevent High Risk Behaviour tendencies like risky sexual behaviour, drug use and violence in them.

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