EDUCATIONAL NEUROSCIENCE PERSPECTIVE TO OUTCOME-BASED EDUCATION AND THE PROCESS OF LEARNING

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Abstract:
Educational neuroscience is an emerging discipline integrating teaching and learning with neuroscientific methods. In the recent past, undergraduate course curriculum is following outcome-based education (OBE) model where, course outcomes are to be attained by students and is a process of continuous assessment. Outcome based education is a theory that gives a systemic structure providing a scaffold for various teaching and learning activities. For an effective implementation of OBE, the process of learning needs to take inputs from a branch of neuroscience dealing with cognitive function. In this work, students concern regarding learning are articulated and then the same are addressed with inputs from neuroscience. Later, this is reinterpreted in the outcome-based education scenario. The present work also consolidates the relevance between levels of Bloom's taxonomy and the educational neuroscience.

Keywords: neuroscientific, cognitive, outcome-based education (OBE), Bloom's taxonomy, neuroplasticity, neurons.

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Introduction

Integrating neuroscience with education has taken its roots in 90's with an effort to improve learning methods [1,2]. Human brain has the ability to reorganise itself based on the inputs given to it and is termed as neuroplasticity. The abilities such as intelligence and creativity are may be modified in students by bringing change in the teaching learning process [3-5]. These studies with in the neuroscience are termed as cognitive psychology. It gives inputs on how a brain processes information. These studies on neuro science help in getting insights towards effective learning methods that provide enriching experience to the students [6-7].

Educational neuro science essentially deals with the parts of the brain involved in the activities of learning. A teacher continuously tries to provide cognitive inputs to the student, which is essentially establishing direct communication with the student's brain. So, it is crucial for a teacher to have basic understanding on the aspects of what he/she is trying to change. For an effective learning experience, a teacher needs to integrate inputs of educational neuroscience in the main stream education. In short, it is adding scientific aspect to the art of teaching.

Currently, undergraduate education is implementing Outcome Based Education (OBE) [8-10]. In the context of outcome-based education (OBE), the course outcomes are to be achieved and it is possible when the student clearly understands what is expected from him/her after learning the content. In an undergraduate Engineering course curriculum, as the student pursues the course meeting the course outcomes, and by enlarge Program Objectives are attained meeting the objective of OBE. This process of teaching and learning needs to proceed seamlessly with meta cognitive thinking among the student community.

Meta cognitive thinking is developed among students only when they are self-aware of their thinking process. To accomplish this, students need to be given inputs on how brain works during the learning process. Cognitive process involved with learning are attention, memory and emotional engagement and they can be measured.

The aim of this work is to bring awareness among students how continuous restructuring of the brain takes place during the process of learning and this knowledge is used by the learner to develop a strategy to enhance their performance with conscious learning.

The study also drives a student to use time management techniques for effective learning.

The present work also draws inferences from the BLOOM's taxonomy and higher order thinking skills that can be achieved using the aspects of neuroscience [11-13].

Methods:

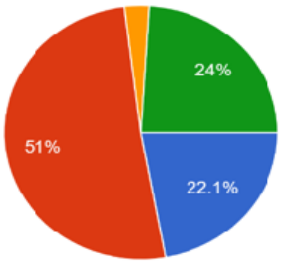
Sample of the present work comprises of 120 undergraduate students and the average age of the cohort is 18 years. Participants have not been previously exposed to aspects of neuroscience connected to learning experience. They have a mixed rural and urban back ground.

To know their concerns regarding learning a pre session questionnaire was conducted and the data was analysed. Based on the data, a session is planned addressing the concerns and connecting with educational neuroscience. Later a post session questionnaire is conducted to know whether they understood the concept of brain-based learning.

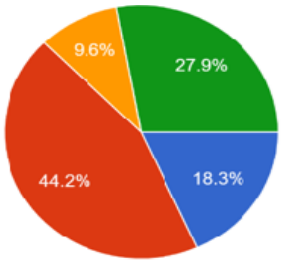
Results and Discussion

Introducing educational neuroscience to students where they do not have any knowledge of the same is challenging. To capture the attention of the students, some case studies across the globe, and educational neuroscience being taught in world famous universities in Cambridge, Stanford was presented [14-17].

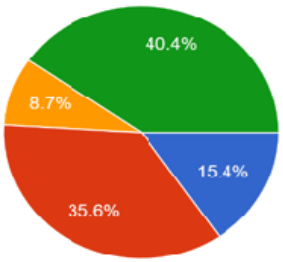
From the pre-session questionnaire as shown in the figure 1, it was understood that nearly 70 percent students were studying with incomplete understanding and nearly 60 percent had concern regarding concentration, 73% students' study without understanding and 50% students procrastinate.

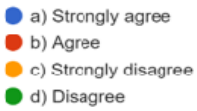


Q1: While studying, even though, I don't Understand the subject, I still study for the exams.



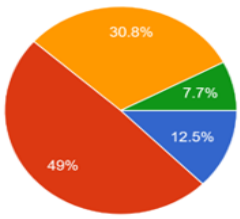
Q2: While studying I can't concentrate because I get distracted easily.



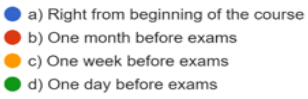


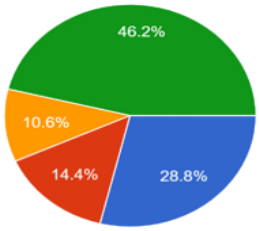
Q3: I Know that, I need to study to get good marks In exam, but time just fly's off.

Fig 1: Likert's type of responses collected in pre-session questionnaire (part-I)

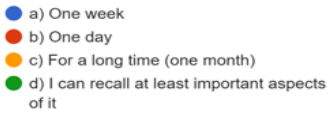


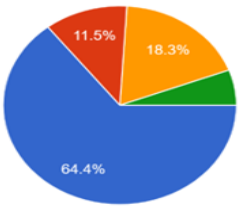
Q4: I usually start preparing for exams





Q5: I study regularly, but have difficulty in remembering. I can remember for





Q6: How often you test yourself?

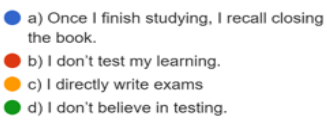


Fig:2 Pre- session questionnaire (part 2)

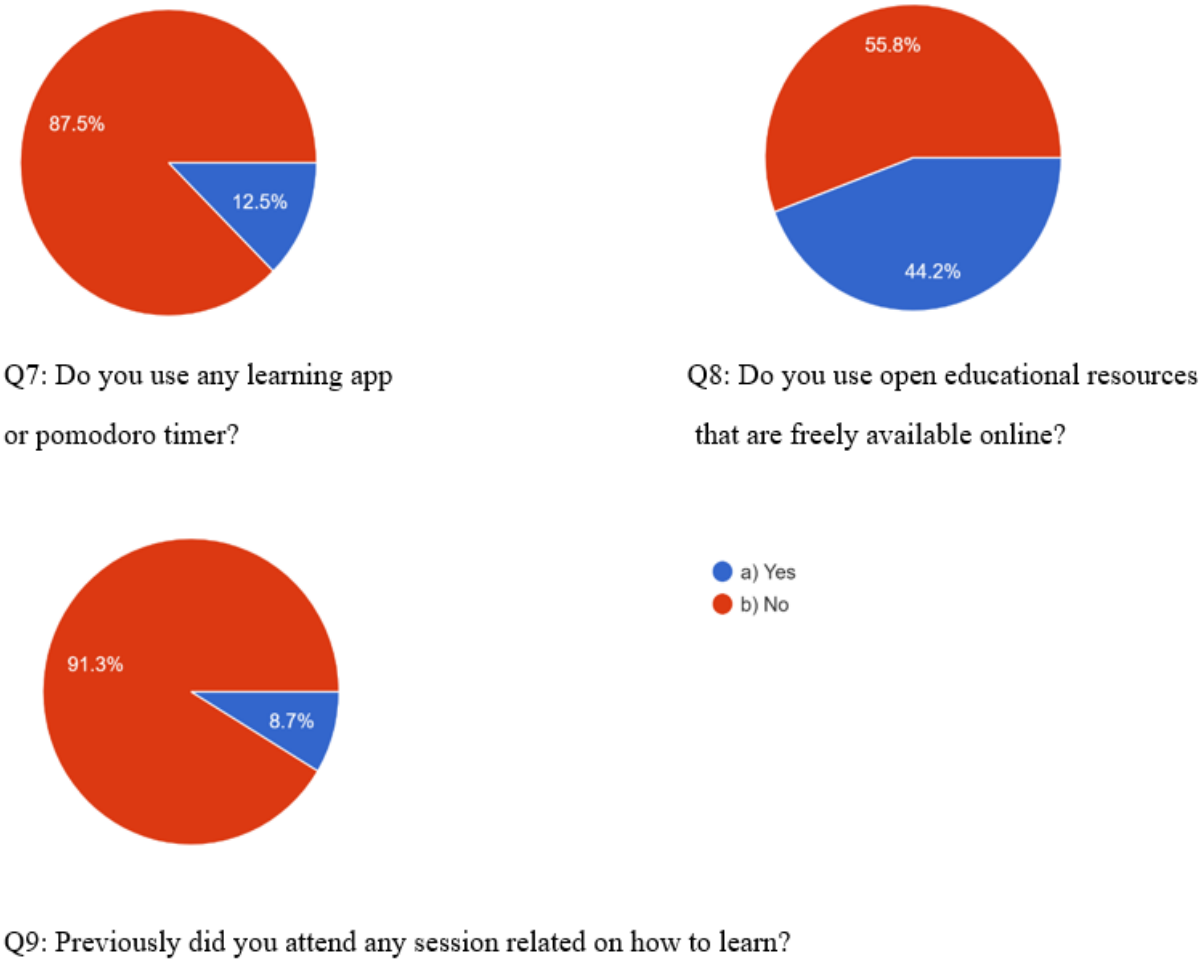


Fig:3 Pre-session questionnaire

From figure 2 and 3, it may be understood that, most of the student's study for the exam just before they have to write, and even though they study, there is a problem in remembering it and most of them do not test themselves before to ensure their learning. It is also observed that students do not use learning app or pomodoro timer for time management. They also do not use open educational resources (OER) for better understanding of the concept. Finally, it was understood that they did not attend any seminar or workshop for insights into brain-based learning.

In the session, students were told how neurons connect with each other and their continuous restructuring during the learning process.

The effort is to make students self-realise the connection between brain function and cognitive function. Time management and its effective utilisation is crucial for learning and from the data as shown in the figure2 reveals that nearly 87% students do not use any learning app or pomodoro timer and in the post session survey as shown in the figure, it is evident that students learnt the pomodoro technique and assured to use to increase their productivity. It can also be observed from the data as shown in the figure2, nearly 50% of the students feel that time just fly's off and are unable to utilise it properly. Usage of learning app and check list comprising of coverage of topics, testing etc ensures that students meet the learning outcomes.

Also, only 12.5% students study right from the beginning of the course and to achieve the outcomes of the course in OBE scenario where it is a continuous evaluation system, student needs to stay motivated and connected to the course right from the beginning [18-20].In this connect, emotional intelligence was also introduced, i.e amygadla and its influence on learning was discussed [21,22]. Students were also made aware of the fact the how development of the frontal lobe in the brain influences them to get involved in risky situations.

As observed in the pre session data, remembering is a challenge and to address this, the concept of long-term memory and the limbic system were discussed. Short term memory, that is used for learning new things should not be given the burden

of remembering as it effects the process of learning new things [23-25].

This was discussed elaborately, as the student needs to practice the concept to be learnt to place it in the long-term memory and make a room for learning in short term memory. Here, the concept of emotional intelligence is reinforced as amygadla influences long term memory. This point is reiterated as in the OBE context, to achieve the Program Objective associated with lifelong learning, the student needs to practice the course relevantly and be able to recall and apply the same in relevant context.

Metacognitive control, where one monitors their own thinking is crucial for a student intending to improve his learning ability. For this, they need to know their style of learning, thinking process etc. This drives the student to achieve higher order thinking skills.

In the post session survey, it may be observed from figure 4, that nearly 86% of the students were willing to test themselves to ensure learning took place and 82% were inclined to use Pomodoro technique for effective time management and 86% students to use OER.

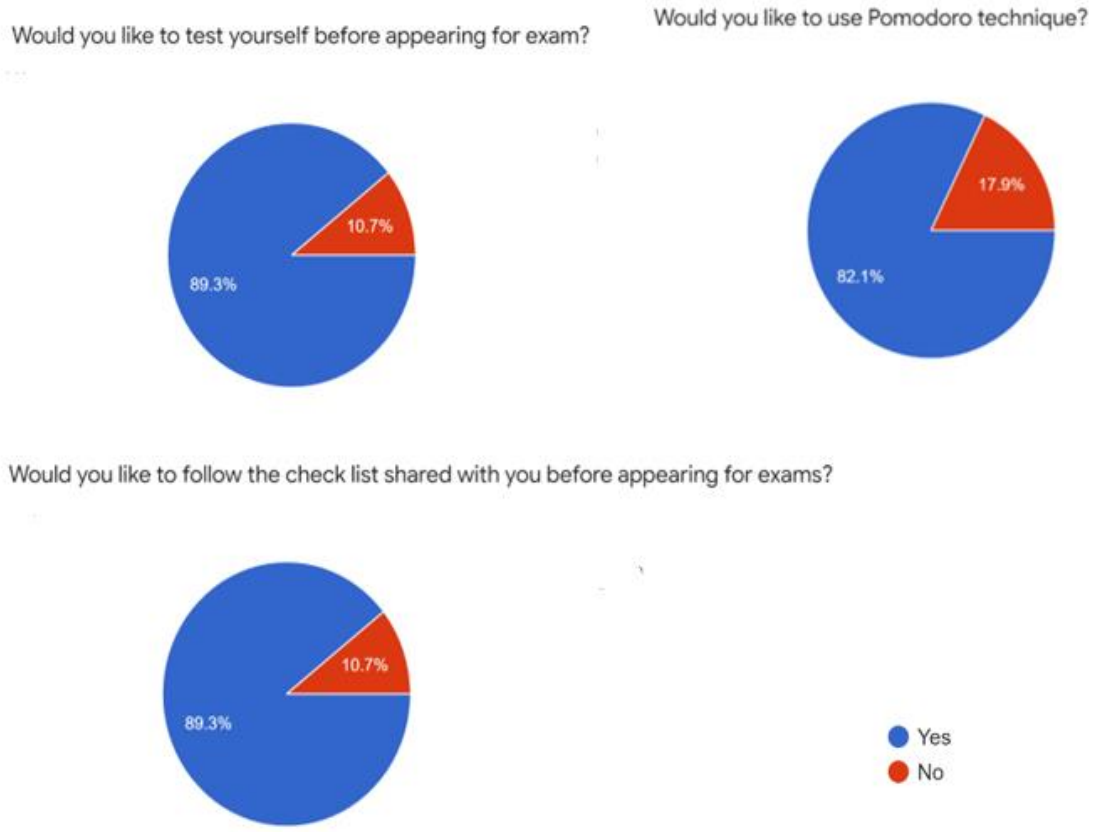


Fig:4 Post session survey (part I)

Based on research inputs, brains do not multitask. Whenever a task arises, even though entire brain is available, only specific paths of the brain are activated [26-27]. So, with the right inputs, students tend to achieve the learning outcomes. In any of the teaching learning strategy adopted by faculty, creating a conducive learning environment is necessary and teacher himself/herself being part of it, should restrain from humiliating, scolding, being sarcastic as it impedes the process of learning and intimidates the student to reach his highest potential.

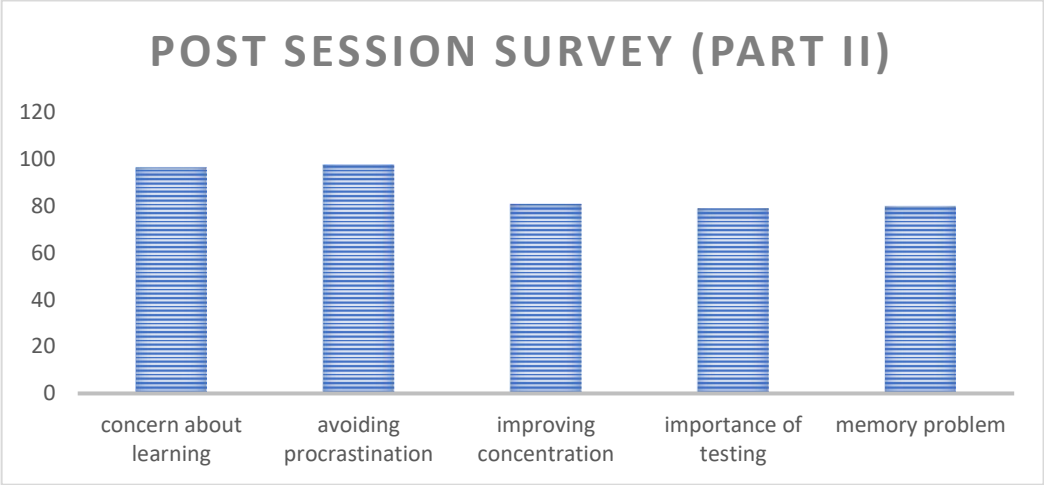


Fig:5 Percentage of students who felt that session addressed requirement for effective learning

There is a need to further strengthen the aspects of session in addressing improving concentration, importance of testing and memory. In OBE course curriculum, there is a lot of importance to Bloom's taxonomy. Table 1, lists the Bloom's taxonomy levels and the possible activities that may be taken up by the student and faculty to achieve the particular outcome and linking the same to the part of the brain involved. It is an undoubted fact that, to bring innovation in teaching learning process, inputs from cognitive neuroscience are to be considered while designing the course curriculum itself to achieve program objective

. Levels in Blooms taxonomy	**Possible Teaching and learning strategies**	**Possible Student learning activities**	**Aspects of educational neuroscience**
Remember	Build knowledge from previously known concepts to the student.	Recollect the knowledge acquired so far and build a concept map of the same.	Memory, hippocampus and other related structures in the temporal lobe. Example: Establishing new connections in the brain and ability to retrieve the information.
Understand	Reinforce the knowledge without any gaps by taking different examples.	Making sense of the knowledge acquired and discuss the same in different contexts.	Long term Memory, Wernicke's area, located in the temporal lobe. Ex: Elaborating the concept with necessary details
Apply	Impart practical knowledge to the students taking real life case studies.	Explore new ways to apply the knowledge acquired with ease.	require a system of interaction between the temporal lobe, prefrontal region and parietal lobe Ex: Ability to apply the concept in a known or unknown learning scenario with a level of discretion.
Analyze	Making various components of the concept and drawing possible connections to various other concepts.	Chose a concept connected to a field of your interest and explore how the concept is being dealt in an application.	require a system of interaction between the temporal lobe, prefrontal region and parietal lobe. Ex: Ability to establish connections with a topic of relevance with ease and draw essential conclusions.
Evaluate	Conduct and moderate peer discussions.	Critically appraise the concept and make valid arguments.	Cerebrum Ex: New knowledge is synthesised and draw conclusions from the same.
Create	Encourage and guide students to do some original work.	Do brain storming and follow design thinking principles to innovate.	Cerebrum Ex: Knowledge is synthesised and it is being articulated in different forms.

Table 1: Bloom's taxonomy and its relation to educational neuroscience

Conclusions

Educational neuroscience focusses on transforming the brains of the students as better learners and critical thinkers. The time has come to make a paradigm shift from routine teaching learning process to brain-based learning to achieve the desired learning outcomes. In the present work, it is clearly understood that undergraduate students need to be given inputs of what is expected from them to get the deliverables. Concept building need to take place in a structured manner to pave a path for creativity and innovation in this knowledge driven digital era. Meta-cognitive thinking is developed only when the brain is trained to do so. Time has come when education system needs to design course curricula by taking research inputs from cognitive neuroscience and integrate new methods for efficient learning. For the intervention of educational neuroscience in mainstream education, it is essential to bridge the traditional teaching and learning methods with collaborative techniques.

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