Title	I think therefore I learn
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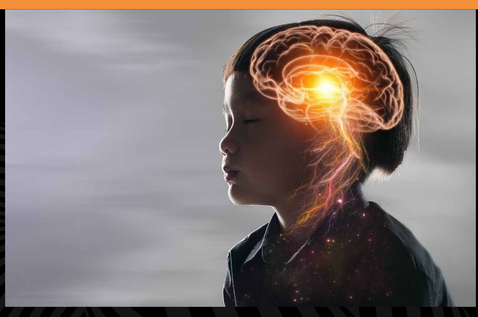
Essays / I Think Therefore I Learn



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Educational neuroscience holds great potential in optimising multi-disciplinary teaching and learning in today's classrooms; the challenge is in translating lab results into learning systems that support real-world outcomes.

As the Singapore educational landscape adapts to meet future challenges and demands, we are also re-examining the way we define and assess learning and the way we teach. Traditionally, formal teaching and learning have always taken place in physical institutions, such as formal schools, universities, religious centres, and hospitals, involving a teacher instructing and students receiving information.

It is not until the last three decades that advancements in information technology changed the way we view education and disseminate information to the masses. It disrupted the way formal institutions conduct lessons, and more importantly, compelled educators to rethink conventional concepts of learning and teaching in a highly connected and digitalised world.

Given the rapidly evolving educational landscape, there is an essential need to re-appraise the way students learn in both conventional and unconventional teaching platforms. One way to truly understand this phenomenon is the use of educational neuroscience.

Educational neuroscience is a rapidly advancing field under the umbrella of the "science of learning". It is a multi-disciplinary approach to understanding learning, having incorporated theoretical knowledge from computational neuroscience, psychology, cognitive neuroscience and learning sciences. Educational neuroscience aims to determine neurophysiological mechanisms that underpin learning in educational settings and help both students and teachers improve their learning experiences.

As neuroscience and educational sciences begin to develop more synergies within education research, educational neuroscience will play a greater role in bridging evidence-informed scientific understandings about brain-behaviour relationships to inform the development of new learning strategies and pedagogical practices through quantifiable methods.

New-age Neuroscience

Neuroscience and the use of neuroimaging technology have greatly advanced our understanding of brain-behaviour relationships, and we are still, to this day, using techniques, such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG), to further our understanding of the brain.

However, these techniques are not without their limitations, especially when it comes to education. As with most neuroimaging techniques, participants are not able to freely move during the scanning process, which limits them to be in a sitting or lying position. While this may be adequate to examine mental processes using computerised tests that do not require large physical movements, it is limiting in trying to understand the neural control of movements or neural mechanisms of behaviour in a naturalistic setting such as a classroom.

To overcome the limitation of movement in traditional neuroimaging systems, new generation untethered neuroimaging systems allow for greater freedom of movement that transmits data via Bluetooth from a portable cap with sensors to a remote amplifier attached to a computer. This method allows for participants to have greater mobility in a naturalistic environment, with researchers located in a separate room to avoid distracting the participants.

Furthermore, the new-generation neuroimaging equipment is capable of collecting data from multiple systems simultaneously, using a technique known as hyperscanning. Hyperscanning allows researchers to not only determine each student's brain activation patterns but understand how brain activities respond in relation to others in the classroom.

For example, a study by Dikker et al. (2017) used portable EEG systems to simultaneously measure the brain activities of 12 students and their teacher in a class. They showed that greater neural synchrony between students and teacher were associated with greater social interaction and classroom engagement. Other research works have suggested similar inter-brain synchrony in predicting performance among group members, over and above their self-assessment of the group.

Such findings point to the value-add of neural data as an implicit measure in studying group dynamics that could not only predict the success of collaborative learning but inform latent aspects of collective performance that is not captured in typical behavioural datasets.

Future of educational neuroscience

While there is great promise in using educational neuroscience to understand the nuances of learning, the field generally is still in its infancy. Educational neuroscience has its fair share of critics from the traditional neuroscience domain as well as education practitioners. To date, the application of educational research in classrooms is still highly limited and are largely confined to laboratory environments.

Some experts have suggested the lack of a proper framework in translating traditional neuroscience methods and protocols from theoretical and 'neat' laboratory research to influence teaching and learning strategies in 'complex' classrooms as a major limitation of the field. Indeed, while theoretical advances have led to controlled laboratory experiments demonstrating their potential for improving education, the translation of these results into effective teaching and learning strategies to positively impact learners in the real world remains an elusive goal.

Others have suggested there could be some misunderstanding on what educational neuroscience should entail as it does not focus purely on brain-behaviour interactions but the ecological influence in classroom environments that could include broader social and environmental factors, such as socioeconomic status, communal relationships, sleep, stress, and exercise.

The objective of educational neuroscience is ultimately to use multiple data sources to achieve a better understanding of learning from a multi-disciplinary perspective. Such integration of multiple data sources can be used to plan interventions and personalise learning tools for students to optimise learning.

Integrating data from multiple sources can, in turn, be informed by multiple theoretical perspectives from the cultural, social, behavioural and biological levels to address the impacts on a diverse group of learners (e. g. K-12; mixed abilities) at the individual, institutional and policy levels.

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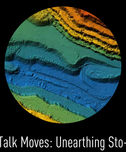

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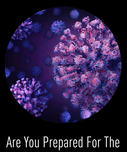

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