The brain on playdo: neuroscience in education

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1 Introduction

If the parent of one of your students asked you to explain what was going on in the head of their child, what would you say? You may panic and sputter something about “left brain—right brain” learning, or that a brain that is fed good nutrition is a brain that can learn, or maybe that most people only use 10% of their brain (a neuro-myth, by the way). If you are like me, when I was a classroom teacher, you would not be able to say much about the brain functioning of your students.

Though teachers are master observers who strive to create strong student–teacher relationships, behavioral observations only tell us so much. You might say, well, I can also do some standardized testing to figure out a bit more about how the child is processing information in their brain. That, too, only gets us so far. We need to go deeper, and yet, educators are reluctant to step up to the neuroscience plate. As Amen (2006) would say, we are among the only professions that never look at the organs that we deal with. Why is it that teachers do not consider the brain? There are several reasons for this, but I would argue that educators absolutely must begin to understand the brain and how it is impacted by teaching and learning.

1.1 Teacher knowledge to inform educational neuroscience research

Teacher training programs do not typically address the brain. Even educational psychology courses fail to adequately discuss the brain and how it relates to affect, body states, and self-regulation. However, many provincial curricula specifically talk about self-regulation to adjust brain and body states. For example, in one province in Canada, British Columbia, the curriculum aims for students to develop “healthy personal practices” and “understand that physical, emotional, and mental health are interconnected” (Physical and Health Education K-10 -Big Ideas Grade K-1, 2019, p. 1).

What do physical, emotional, and mental health all have in common? The brain. Healthy brains support overall health and wellness. As Rueda (2020) noted, it is a closed loop where optimal learning leads to optimal brain functioning, which is essential, and then leads back to optimal learning. Therefore, the brain and how it functions or does not function are relevant to every teacher, regardless of their curriculum specialty.

Some, such as Dr. Stephen Campbell, founder of the ENGRAMMETRON: Educational Neuroscience Laboratory at Simon Fraser University in Canada, would contend that it is essential for teachers to learn about neuroscience and the brain to maintain agency within education (Campbell, 2011). His fear is that educational neuroscience will be dominated by scientists and neurologists, with little input from educators. Then, all research and treatment would be driven by the scientists and not educators, and the knowledge...
generated would remain clinical and potentially not practical, translatable, or usable. This outcome has been one of the barriers to educators stepping up to the neuroscience plate. Interdisciplinary collaboration (in this case, neuroscience and education) is challenging and well-documented by others (see Brown and Daly, 2016; Palghat et al., 2017). As Bruer (1997) posited, it is simply a “bridge too far” (p. 4).

At the very least, teacher training programs must include educational neuroscience in their curriculum. If teachers are better informed about the brain/body/behavior connection, they are less likely to believe neuromyths (Dekker et al., 2012; Torrijos-Muelas et al., 2021), such as “right-brain/left-brain learning”. Additional neuroeducation also leads to more positive attitudes for teachers dealing with students with complex needs (Chang et al., 2021; Gola et al., 2022). Inservice teachers can bridge the knowledge gap by reading peer-reviewed publications or taking graduate courses in educational neuroscience (Torrijos-Muelas et al., 2021). Amiel and Tan (2019) and Tan and Amiel (2019) have demonstrated how collaborative action research enhances teachers knowledge and application of neuroscience concepts.

Another solution to the “bridge too far” common in interdisciplinary collaborations is to embed scientists in schools, jointly researching how neuroscience informs the learning and teaching process. One example of collaboration between educational neuroscientists and teachers is the Synapse School in California, which is connected to Stanford University’s Educational Neuroscience Initiative. They created the Brainwave Learning Center within the school, and their educational neuroscientists play an integral role in the day-to-day functioning (White, 2023). Director Lyn Toomarian notes that there “has always been this … separation between neuroscientists studying the way kids learn and the places where kids are actually learning….but we’ve been able to integrate the two” (White, 2023, p. 4). It is an excellent example of bringing neuroscience into the school and successful interdisciplinary collaboration.

However, even if you do not have educational neuroscientists in your school, there are many other reasons to stand up and pay attention to the brain.

1.2 Examples of neuroscience in education

Science and education have come a long way from “right-brain, left-brain”. Every day, teachers are changing the brains of their students, and, at present, we have the technology to see how pedagogical choices impact the brain in different ways (Brult Foisy et al., 2020). For example, McCandliss (2011), Yoncheva et al. (2015) have investigated the impact of different reading programs on both skill development and brain changes (structural and functioning) using electroencephalogram (EEG) technology. This is not science fiction! Imagine that you would be able to determine the best teaching methods for a student based on their brain activity! Another example of adapting pedagogy/curriculum based on neuroscientific data relates to printing and handwriting. Though many primary schools have removed formal printing/handwriting instruction from the curriculum, James (2017) found that handwriting is important for brain development and specifically supports learning to read. Furthermore, research has also revealed distinct phenotypes or biomarkers of brain activity that are directly related to learning and emotional behaviors. That is, by looking at brain activity, we can identify or anticipate learning or emotional challenges that a student may experience (Xiao et al., 2023). There are specific applications for special education by identifying where in the brain cognitive processes are breaking down or may be bottlenecked (Kropotov, 2016).

Yet another application of neuroscience in education could be to measure brain health throughout a child's education, and in particular, if students are involved in physically demanding contact sports. Using EEGs, we could measure brain health in our student athletes at the beginning and end of each sport season, which is vitally important should they sustain any head injuries (Thanjavur et al., 2021). Finally, another application of neuroscience in education is simpler and more direct. Students themselves can learn about their own brain and body functioning, and acquire appropriate strategies to self-regulate (Moreno and Schulkin, 2020; Goldberg, 2022). After all, is not this one of our main goals as educators and which reflects the demands of the curriculum, as stated at the outset of this paper?

2 The new beyond

There are many realities that our students encounter, including digital technology. Numerous devices are available that can alter brain activity, such as the Muse (Science | MuseTM EEG-Powered Meditation and Sleep Headband, n.d.), which teaches the user to calm the brain and body, or more radically, a brain chip to implant memories (Hern, 2024). In addition, the use or misuse of gaming (Swingle, 2019), social media, virtual reality (Kaimara et al., 2021), and online learning (Firth, 2019; see also Tokuhama-Espinosa, 2021) will impact the developing brain. Educators need to know the impact in order to appropriately adjust pedagogy and policies. Why would we leave these types of applications to non-educators? If educators understood more about the brain and why it does or does not learn, they would be optimally situated to guide interventions and seek appropriate pedagogy. Again, to do this, we absolutely must learn about basic brain functioning.

As we plunge into this new reality, we are right to be cautious. Indeed, there are numerous ethical issues to consider. One of these issues relates to the use and security of the biometric brain data collected (Guidelines for Practice | ISNR | Neurofeedback Training and Research, n.d.). Another issue is using technology as an intervention, and there is a need to research the long-term impacts of devices such as the Muse, a neurofeedback device (Thibault et al., 2016), or other brain stimulation technologies on the developing brain. Fortunately, the IEEE (Frankston et al., 2021) is working to develop a neuro-ethics framework for use in education and other disciplines as a starting point to guide our plunge.

My challenge to you, as educators, is to learn as much as you can about the brain now, despite a potentially steep learning curve. This can be done by enrolling in a course in educational neuroscience, reading peer-reviewed journals, or finding out more about the work of neurotherapists and how
they can complement the teaching and learning process. We can no longer ignore what is going on inside the heads of our students, and more importantly, we have the technology to do it!

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