You Want Me to Teach WHAT?

Sure-Fire Methods for *Teaching* **Physical Science** and **Maths**

Norman LaFave

Hawker Brownlow
EDUCATION

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CHAPTER 1

Inside the Teenage Noggin

The Research Findings

A teacher's success in instructing teenagers is substantially enhanced the more the teacher understands teenagers. This seems so obvious, but our knowledge of the teenage brain has evolved in recent times, with many of our traditional assumptions suddenly under scrutiny and up for debate (Epstein 2007; Lorain 2002; Reyna and Farley 2006; Underwood 2006).

Research that uses magnetic resonance imaging (MRI) technology to track the blood flow in the brain during various stimuli demonstrates a clear difference between the response of the teenage brain and the adult brain. In addition, Jay Giedd (Giedd et al. 2009) has employed MRI technology since 1991 to map brain development and has demonstrated that the development of the brain can occur up to the age of 25, well past the age once thought. Indeed, it was once believed that the brain was near fully developed in the early years of a child's life. The work of people such as Dr Spock was predicated on this belief. Well-intentioned parents crammed education into their children to beat this clock. It is true that most brain development does occur during this early period, with most synapses established, but it does not mean that substantial development does not occur later, as recent research suggests.

Scientific research has tracked two processes that occur over time in the development of the teenage brain: *arborisation*, which is the development of the grey matter of the brain by the creation of new dendrites, and *regressive pull*, which balances arborisation through the competitive development of some grey matter while other areas are sacrificed.

The quantity of grey matter usually peaks during ages 12–13, after which the amount of white matter increases. At this point, myelination (the sheathing of neurons in insulation to improve performance) occurs. This process is dynamic and allows the early teenage brain to adjust to its environment. As stated earlier, this process continues until age 25.

Between brain development, changing hormonal make-up and environmental stimuli, there can be no doubt about what adults have known for years by experience: teenagers are different. The researchers may debate the issue on the relative effect of the three factors, but the end results are indisputable.

So, what have the researchers learned, and how does it affect our approach to teaching? It is all about recognising and adapting to behaviours displayed by teens.

Teenagers Process Emotions Differently.

Indeed, they seem to process their emotions in a different part of the brain than adults do. They find it more difficult to interpret body language, speech and facial expressions correctly. Researchers suggest that this is the reason they are more likely to clash with their peers over issues that never would cause conflicts between adults.

Teachers need to recognise these tendencies when arbitrating disputes between students. Guidance of the disputing parties is the key, as the teacher may have to take the lead in making both parties recognise the real cause of the dispute. Staying calm is crucial, as the teacher must also take the lead in tamping down emotions. It is never a good idea for the teacher to over-react, which might aggravate the dispute.

Teenagers Have a Difficult Time Working During Times of Heightened Emotion.

Studies demonstrate that if a student learns a lesson under emotional duress, they are less likely to remember the lesson later. Teachers must constantly monitor the behaviour of their students and be aware of their emotional state. On days where extreme distress (or happiness) is evident, some flexibility in expectations by the teacher is prudent. This can be a challenge early in a class where the teacher has not had much time to observe students' normal behaviour patterns. At this stage in getting to know students, teachers must be observers of both work habits and behaviour to establish a baseline.

The Sleep Cycle Changes Drastically for Teenagers.

A child who had no problems going to bed early and getting up early suddenly cannot go to sleep until a later hour and becomes difficult to wake up in the morning. Given that we force these teens to awake earlier than their brains want them to, the result is that teenagers are often sleep deprived. This causes students to forget 20–30 per cent of what they learn due to loss of REM sleep, when the brain does much of the integration of new information.

It is one irony of our modern education system that these teenagers, who are now in need of more sleep in the morning, are often the first ones in school in the morning.

This policy is driven by issues of safety for younger students, but it flies in the face of this new understanding of the teenage brain. It partially explains the frustration teachers often feel when students forget lessons from the previous day.

There is little that a secondary school teacher can do to change the education system in which they work, but understanding this phenomenon can be used to refine expectations and drive reteaching of material. It should also cause adjustments of curriculum pace to compensate. Teachers can also work with parents to encourage their kids to slow down in the evenings earlier and catch up on their sleep on weekends.

Sleep Deprivation Increases the Risk of Developing Depression in Teenagers.

Given that many mental health problems develop in the teenage years, this must be a serious concern for teachers and other professionals involved in the lives of these students. Teachers must constantly monitor their students for changes in behaviour or work quality that may signal the onset of depression or more serious ailments. Concerns should be expressed promptly to counsellors or principals if a teacher believes a student has mental health problems.

Teenagers Exhibit a Propensity Toward Experimentation and Risk Taking.

Any adult who has been exposed to teenagers knows this without the help of researchers. Teenagers are more likely than younger students or adults to experiment with alcohol or drugs, have unprotected sex, drive under the influence and dabble in dangerous activities. Some researchers believe this is a natural process that is part of the teenagers' forming identities. Still, it is imperative that adults, including teachers, monitor these proclivities and respond accordingly to keep harm from occurring to the teenager or the people around them.

An additional concern for teachers is the effect of drugs and alcohol on learning. Some research suggests that drugs and alcohol damage the ability to memorise and learn in the hippocampus of a teenager's brain. This should motivate teachers to be especially vigilant in observing signs of drug and alcohol abuse in the student population.

As stated earlier, there is some debate about whether these findings are better explained by brain development or exposure to a particular environment. There is some evidence that environment may trump simple brain development, because teenagers in Eastern cultures display somewhat different behaviours. But from a pragmatic standpoint, the cause is not important. Secondary school teachers still need to keep the resulting behaviours in mind when performing their duties and interacting with students.

What About the Effect on Learning?

Research clearly shows that brains continue to develop well after what was once considered the brain's development period. Even more important for learning is that the rate of development will vary with the individual. This means students will develop their abilities in higher-order thinking in their own time.

What does this mean to the teacher? The teacher must be more flexible and provide scaffolding of the lessons when necessary. Now that we know the truth about brain development, we must guard against the usual rigid expectations of higher-order abilities at a given age so that we do not frustrate and damage the confidence of a student just because nature has decided the student will gain cognitive abilities later than their peers. Teachers must assist the natural development by providing tools and methods (discussed later) that promote it in an environment that allows students to stumble without consequences. Finally, teachers must be patient and provide encouragement as the natural process takes place.

Here are some specific suggestions for teachers:

- *Place comments on homework and classwork without a numerical mark so that students can learn without the fear of failure.* Confidence is important and fragile. By de-emphasising marks during the early learning process of a unit, students are free to make mistakes and learn from them without fear getting in the way. In addition, students are more likely to ask questions and make progress toward mastery when fear of marks is not a factor.
- *Use oral quizzing (no marks) to assess the degree to which a student can perform functions of higher-order processing.* Nothing is more valuable for the assessment of higher-order skills than probing questions while the student performs learning tasks. Teachers should direct the questions in a way that assesses the student's ability to be systematic, see relevant patterns, conclude from data and calculations, and break complex problems into smaller units. The teacher can then guide the student toward incremental improvement of these abilities.
- *Mark for improvement and mastery.* This change in philosophy provides assessment while acknowledging the variability of brain development. It requires a degree of flexibility and new thinking that many teachers find difficult to accept. Still, if our goal is to get the best out of each and every student we teach, the variability of brain development must be accounted for in assessment.
- *Use the methods in this book to enhance and accelerate the development of higher-order thinking skills.* Although the brain's development rate is unique to an individual, the teacher can still provide tools to enhance and accelerate the process. This book provides tools to build a student's ability to see patterns, systematise their thinking, conclude from data and analysis, and break down complex problems into a series of simple problems. These are critical skills for building higher-order thinking abilities.

References

Epstein, R. 2007. The myth of the teen brain. *Scientific American Mind*, April/May, 56–63.

Giedd, J. N., F. M. Lalonde, M. J. Celano, S. L. White, G. L. Wallace, N. R. Lee and R. K. Lenroot. 2009. Anatomical brain magnetic resonance imaging of typically developing children and adolescents. *Journal of the American Academy of Child Adolescent Psychiatry* 48 (5): 465–470.

Lorain, P. 2002. Brain development in young adolescents. National Education Association. *www.nea.org/tools/16653.htm*.

Reyna V. and F. Farley. 2006. Is the teen brain too rational? *Scientific American Mind*, December, 58–65.

Underwood, N. 2006. The teenage brain: Why adolescents sleep in, take risks and won't listen to reason. *The Walrus*, November. *www.walrusmagazine.com/articles/2006.11-science-the-teenage-brain*.