Re-inventing schools from the brain up- A discussion paper

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The purpose of this paper is to create discussion and debate about how schools would function if they were the based on the most recent brain and learning research.

It often seems that we are trying to prepare young people for life in the twenty-first century, using teaching methods developed in the twentieth century and a design for schools that emerged in the nineteenth century.

Schools are overdue for an upgrade. Let's discuss and debate what schools would really look like if we based them on the available research on learning and neuroscience.

Start with the emotions

Learning is an emotional business. This is true at any age but especially true for children and adolescents. For much of this time, new learning is filtered through the brain's limbic system where feelings and emotions are processed.

The reticular activating system (RAS) processes information from our senses and the amygdala screens it for threat before we even get a chance to think about a new piece of information.

If threat is perceived then the fight- flight response kicks in and survival takes precedence over learning. This is why lowering anxiety, threat and building a positive mindset that allows students to have a go without feeling at risk of being shamed is vital for learning.

We learn and remember things that we have an emotional investment in. The importance of emotions to learning suggests that schools should link literacy with activities that emotionally involve students such as drama and theatre sports.

Some students are not emotionally excited by all of the aspects of the curriculum. However they are invested in having connections, relationships and positive feedback.

Young people live in a world that is time and relationship poor. This makes them hungry for adults who care and make them feel safe and who believe they can succeed. The traditional secondary or high school model of having each teacher to try to cope with success for 150 to 240 individual students and to write meaningful reports on each does not work.

Nurture positive values

Successful schools nurture good souls. Brains develop as morals develop. Well functioning brains are able to reflect upon the consequences of actions, consider morally complex and ambiguous situations and to treat people compassionately. Young people develop this when they are guided by parents and schools that have a clear values-based approach.

About 45% of any school's population have attachment issues. For these students trust, wariness, hyper-vigilance and insecurity are major barriers to learning. Living the core values of happiness, belonging and safety for all, acts as an antidote to the barriers to learning experienced by insecure or avoidant students.

We need to think about how the findings of Neil Hawkes' International Values Education Trust (www.values-education.com) and Marjorie Boxall's Nurture Groups can be adapted for use with students of all ages.

Enrichment and Synaptogenesis

Schools should aim to provide an enriched environment that develops synapses in brains (also known as synaptogenesis). The diagram below shows the activities that promote synaptogenesis, enrichment, or *both*.

Synaptogenesis <----------> Enrichment

* High levels of feedback	* *Contrast & difference*	*Intrigue & experiencing differences
* Repetition	* *Challenges*	* Physical activity
* Ample rest	* *New learning*	
* Serotonin	* *Low to moderate stress*	* Sufficient time
	* *Complexity*	
	* *Spaced repetition*	

Clarity of Purpose

Intentionality and awareness drive energy. Goals drive behaviour. There is clear evidence that when people set specific targets they often exceed them. Individual learning plans go some way towards accomplishing this but often are too complex for anyone to keep in mind.

Having one single goal for each student each term is more likely to achieve improved outcomes. This involves staff having time to set a goal for each student, to have time mid-term to review and gain additional support if progress was not being made and a time with the student at the end of the term to hopefully celebrate the progress they have made.

Deliberate practice

Results improve when we concentrate our practice on the skills we are not so good at. We all tend to practise the things we find easy but avoid the things we struggle with. When we deliberately set time aside to practise the skills we lack our outcomes improve dramatically. Therefore, there should be times when students in the same class should be doing different types of homework and practice to help them develop different skills.

This is linked with intentionality. Asking students to practise the next small step that would make a difference creates incremental improvements. Over time this increases performance. If we can set a specific goal for each student each term and then provide them with opportunities to practise their skills in that area they will accomplish outcomes they won't believe.

Repetition

It takes humans 24 repetitions to get to 80% of competence. Repetition also builds mastery and synaptogenesis.

One major implication of this research is that schools should think long and hard before sacrificing regular (daily) exposure to the information in each subject area for longer learning times but fewer repetitions.

Spaced repetition pays off even more

"Spaced repetition" has a positive impact on learning. Instead of concentrating the study of information in single blocks, learners encounter the same material in briefer sessions spread over a longer period of time.

Spaced repetition produces impressive results. A study completed at the University of California-San Diego in 2007 found that Year 8 history students who relied on a spaced approach to learning had nearly double the retention rate of students who studied the same material in consolidated units.

This research implies that the more times students encounter information the more likely they are to understand and retain it.

Mixing it up and Interleaving

Mixing up tasks also pays off. For example we might do a short set of subtraction problems, some reading, some writing and then some addition problems.

Interleaving is when students practice different types of skills and it powerfully increases results.

A study published in the Journal of Applied Cognitive Psychology asked fourth-graders to work on solving four types of mathematical problems and then to take a test evaluating how well they had learned. The scores of those whose practice problems were mixed up were more than double the scores of those students who had practised one kind of problem at a time.

Learning occurs in a context. Spaced repetition of the same problem in a variety of contexts increases outcomes.

Brain Leaps

Research also suggests that it is when we shift from one area of learning to a dissimilar area that we learn fastest.

For example if you have a tennis lesson and then followed this with a golf lesson the skills gained in both lessons would conflict and you would improve more slowly. If instead you shifted from English to Mathematics to Art and then to Science the skills learned in each would remain distinct and outcomes improve.

Self-explanations

Students who are able to explain to themselves the steps involved in solving problems achieve better academic results. Learning to mentally process the steps of solving a problem e.g., "First I've got do … then I need to … and then I can…" utilises one of the most powerful brain abilities- patterning knowledge. Therefore, lessons should not only require completing problems but trying to help students understand and outline the process of solving problems. Explaining a process to others often helps clarify our own thinking.

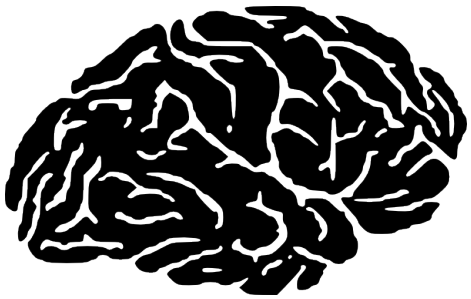
Move it, use it or lose it.

Many boys and some girls learn best standing up. Humans remember physical movements and gestures better than anything else.

Our devotion to learning that is desk-bound, paper-based, syllabus-driven and test-proven stultifies too many of our students. We need to bring physical movement, enactments, learning games and liveliness back into classrooms.

Open learning areas- great for some disastrous for many.

The trend of implementing open learning areas with teams of teachers has not been based on research. In some areas it appears to work well and brings vibrancy and choice into learning; in other areas it appears to detract from learning. Where there are a high proportion of refugee families, stressed students or auditory processing problems, open learning areas are likely to increase vigilance and distractibility.



Students and parents need to have one main teacher who knows them and has the time and the power to develop meaningful plans for improvement.

Music and Mathematics

When we become more familiar with a new area of information our brain doesn't have to work so hard to process the knowledge. As expertise increases, brain functioning becomes more focused.

With literacy, the part of the brain that does most of the work is just behind your left ear- the ventro-occipital-temporal region. In mathematics, it is a part of the brain called the intraparietal sulcus. Located in the parietal lobes, this part of the brain not only processes mathematics but

also movement, rhythm, movement and music. This is why linking music and movement to mathematics is highly likely to see improvements in numeracy outcomes.

Passion projects

Students learn best when the information is emotionally engaging and is relevant to them. The perceived relevance of the topic is more powerful in improving learning than whether you have a student or teacher centred curriculum. It is more powerful than providing electives or negotiating curriculum.

Shedding some of the "busy" work that plagues most schools to free up time for students to develop passion projects makes sense.

Students completing projects of interest to them results in amazing leaps in learning. The findings of Big Picture Schools, Montessori education and Challenge–based learning are impressive in this area and show that these types of projects can contain rigour and mastery.

Single tasking

When you multi-task you have the feeling that you are getting more done in less time but it is an illusion. When students are distracted and multi-tasking the neural circuitry that underpins learning a new concept is often not formed. On average it takes 400% longer to learn the same amount of information when you multi-task and the likelihood that you learn it patchily increases.

In a world of infoglut and concentration deficit syndrome, school is one of the few places where we can switch off the music, the electronics and engage in deep, meaningful, enquiring conversations.

Multi-sensory classrooms

The research on optimal learning spaces indicates that they are most powerful when they involve all of our senses. The aroma, colour, feel, temperature and sound of classrooms is worth planning for as much as the way that they look. Students learn best in well-designed stimulating surroundings that are run by caring adults who make them feel empowered and safe.

VIsion wins!

Of all the senses we use for learning, vision is the most powerful. Seeing information laid out help us to understand and remember it.

While we want to engage all of the senses, adding more visuals to the information you want students to learn pays off most. That means the time spent preparing drawings, art, graphs, mind maps, concept maps, flow charts, signs, cartoons, storyboards and models is time well spent.

Dream factories

Dream factories are think tanks where students dream about the creation of a better world.

Students' brains grow quickly when they are challenged to be curious and creative. Challenges also build dopamine – the foundation of motivation. One of the best ways to accomplish this is to involve young people in projects that make a difference in the world. There are already many examples of social media creating changes in the world and schools need to focus on embracing rather than policing this possibility.

A student starting school in 2012 will graduate in 2025. We can't know exactly what skills will be needed then. It is likely that young people will need to have a sense of empowerment and the ability to innovate.

Developing experiences in social entrepreneurialism where positive solutions to issues facing our world are discussed and developed would meet this need. To accomplish this schools will need to engage government, business and community leaders.

If you would like to discuss issues related to this topic or to investigate links and ideas go to "The Learning Brain" page on facebook.
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