

Why Teacher Education Should Include Neuroscience



~ Marinus Bell ~

“The more we build these networks and enrich our stores of memory and experience, the easier it is to learn, because what we already know serves as a foundation for forming increasingly complex thoughts.”

— John J. Ratey, **Spark: The Revolutionary New Science of Exercise and the Brain**

As students, we are all but too familiar with schoolteachers and/or university/college professors who knew their subject matter well, but their teaching skills or methodologies hardly ever encouraged engagement. To be able to stay awake in their classes/lectures required massive efforts (or lots of coffee). They were never trained to develop the skillset of applying engagement teaching strategies.

Changes in society, technology and pedagogy informed curriculum change at school level. As computer technology became an asset in classrooms, schools of education involved with teacher education appropriately included the instruction thereof in the teacher-training curriculum. Similarly, research in the field of neuroscience in education has proved to be an invaluable asset to the classroom. The time has thus arrived to include instruction in the neuroscience of learning as an essential part of professional teacher education.

The world is changing rapidly – change has become the norm. The 21st century demands the development of a necessary skillset not previously needed. For today’s students and learners, teachers are a lifeline that they need to climb to access the opportunities the 21st century offers. There is a certain breed of teachers needed during these turbulent, yet exhilarating times. They are the teachers who are motivated and armour themselves with knowledge on how the brain thinks, functions and learns, and apply that knowledge in the classroom. These teachers will become change agents that help children extend their own knowledge on how their brain works, and unlock children’s’ brain potential regardless of previous performance, to reach their highest potential.

Teachers can help learners change their brains and per implication, intelligence, by understanding the neuroplasticity (the brain's ability to reorganise itself by forming new neural connections throughout life) of the brain. Teachers who do not understand the implications of brain changing neuroplasticity as profit or gain for their learners, are at risk of great loss to not unlock and utilise the full brain potential of their learners.

Beyond understanding the brain's neuroplasticity to stimulation, how activation and the use of memory networks make the networks stronger, future teachers need to recognise how stress inhibits neuroplasticity.

Stress, which is a reality to everybody, and even more so in the field of education, has the ability to cause a learner to lose control of his/her non-dominant hemisphere, which places them at risk of not performing as well they can. It is only when information is processed in the brain's reflective, cognitive prefrontal cortex that new learning can be incorporated into networks of long-term, conceptual memory. For that to happen, students and teachers alike have to understand their own neurological wiring. The principle, '*know yourself that you can manage yourself,*' is of force.

The neuroscience of how the brain thinks, learns, processes information and what influences the successful acquisition and application of information, should be included in all teacher education programs. The understanding, application and implementation of information regarding the neuroscience of learning should be prerequisite foundational knowledge for teachers. Knowledge regarding neuroscience will enable teachers to increase the effectiveness of learning transfer, and enhance and sustain the joy element when it comes to learning.

The professional development of teachers needs to incorporate knowledge about and tools to equip learners for the game-changing realities of globalisation. There should be core mandatory standards that align the preparation of prospective teachers with the realities and challenges of globalisation. This would *inter alia* include knowledge about how to equip learners with the thinking skills sought by employers, namely: Creativity and innovation, critical thinking and problem solving, communication and collaboration, flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability and leadership and responsibility. Brain networks can be strengthened so that all learners acquire the mentioned skills.

Linked to the aforementioned a recent report published by the World Economic Forum entitled *The Future of Jobs*, states that the fourth industrial revolution is on its way. It will cause widespread disruption to business models and labour markets over the next five years. An enormous change in the most desirable skills to thrive in the job market is predicted. The table below illustrates the top 10 most wanted skills in 2015 as compared to the skills that will be needed in 2020:

In 2020	In 2015
1.Complex problem solving	1.Complex problem solving
2.Critical thinking	2.Co-ordinating with others
3.Creativity	3.People management
4.People management	4.Critical thinking
5.Co-ordinating with others	5.Negotiation
6.Emotional intelligence	6.Quality control
7.Judgement and decision making	7.Service orientation
8.Service orientation	8.Judgment and decision making
9.Negotiation	9.Active listening
10.Cognitive flexibility	10.Creativity

In order to develop these skills, teachers need to understand the how of the most effective teaching strategies. They also need to be motivated to best utilise these strategies, and expect positive outcomes when applying the strategies.

Apart from the global realities as mentioned above, these topics also require an understanding of how the brain "pays attention", encodes new input into working memory, uses neuroplasticity to construct long-term memory, is influenced by stress, and develops its neural networks of executive functions (memory, cognitive flexibility and inhibitory control). The highest cognitive skillset of the brain is its vast potential of neuroplasticity (the ability to develop and improve student's brain networks). Not only do teachers need to

be aware of this, but they also need to play an active role in implementing the developing the harnessing power of this potential during the learning process. It needs to be entrenched in the fibre of the learning content and the transfer thereof.

Who will be the teachers that will be the most prepared and equipped to guide students for the 21st century? They will be teachers with a foundational understanding of how the brain thinks, learns and processes information, teachers who will equip learners with strategies to transfer knowledge into long-term memory, and teachers who will assist learners to develop the ability to think critically and translate knowledge input into practical reality within a fast changing world and learning environment.

Teachers play a pivotal role in influencing students' habitual ways of thinking, namely the neuron pathways that determine what positive mind-sets (neural pathways) are formed. This deliberate influence that teachers have can alter students' life paths in such a way that they leave schools not only with brains optimised for the future, but with brain-based tools to be successful in all spheres of life.

An introduction to the basics of the neuroscience of learning should be included in all teacher education programs. It is possible to teach the basics of neuroscience and the implementation thereof in a single day of instruction. Ideally, there would be additional opportunities for future teachers to pursue further inquiry into the science of how the brain learns, retrieves, and applies information. The practical outflow of neuroscience into particular subjects might need attention, but there are more than enough resources available to aid the teacher. It does however require a mind-set change for the teacher, but the pay-off is profound. This mind-set change refers to disregarding notions of fixed ability as flawed and out-dated.

IQ is not fixed at birth and brain development and intelligence are "fluid" in that deliberate, calculated efforts that help change the neural connections and pathways equate to higher intelligence. It is about the amount and the 'quality' of the connections made. Teachers have the opportunity to help all children build their brains beyond what was previously believed to be fixed limits based on learning disabilities or the predictions of test scores or achievements.

The good news is that cell growth never stops. Yes, we lose brain cells as we get older, BUT, we know now that through neuroplasticity (continual interneuron connections), subjecting ourselves to learning and experiences throughout our lives, the principle holds – use it or lose it. Continued use of the brain will yield continued positive results.

"Neuroscience proves that the brain has unlimited learning potential. Therefore, there is no limit to what people can become. Companies and educational institutions are the sum total of the collective brain power of their people, so there is also no limit to what and who companies/schools can be if they continuously invest into the learning potential and competence of their workforce/teachers" says Dr. Andre Vermeulen, CEO of Neuro-Link, a company that specialises in the neuroscience of workplace learning"

Neuroscience brings to the fore findings from hard sciences such as physiology, chemistry etcetera, is inclusive of all cultures, races, genders and generations, and complements behavioural sciences and integrates easily with different learning technologies. There are certain fundamental premises of the neuroscience of learning that are essential for any teacher who really wants to understand the potential of the brain and how to optimise performance.

All learners, facilitators or practitioners engaged in the field of learning, responsible for preparing children, students and workers for developing the skills necessary to prosper in the new landscape predicted for 2020 will be well-served to have a clearer understanding of issues such as:

- The biochemistry of learning and thinking.
- Neuroplasticity and cognitive flexibility.

- How the brain works and processes information.
- Learning implications of the different brain areas.
- How to identify and improve the drivers that optimize brain performance.
- How to determine people's unique neuro-design and learning potential.
- How to prepare the brain for learning, thinking and creativity.
- How to activate the brain for learning.
- How to improve brain fitness.
- How to maintain brain health.
- Advanced visual skills for 21st century workers who process volumes of information.
- How to develop complex problem solving, critical thinking, creativity and memory skills for 21st century workers.
- How a person's neuro-design affects health and safety in the workplace.
- How a person's neuro-design affects their sense of purpose, engagement and performance.

Therefore, any person who is responsible for the learning and development of another should strengthen his/her understanding of the neuroscience of learning and apply this evidence-based knowledge to their practice of human capital development.

The neuroscience of learning is a promising field that provides sufficient evidence that can be put in practice in order to validate learning as one of the essential ingredients for improving the performance of the workforce, and productivity in profound ways.

Learning starts when a person's brain processes information. This information is absorbed through the senses, processed to the different sensory lobes at the back of the brain, and then it is processed to the expressive centre of the frontal lobes and organized in neural pathways. All people have a unique genetic coding which will cause them to have a genetic predisposition towards which lobes, hemispheres and senses will lead (dominate) when processing information.

The unique combination of brain hemispheres and the expressive-receptive, the rational-emotional, and the sensory and intelligence preferences makes up a person's neurological design. All people have different preferences and it is essential that any learning organization needs to design learning experiences and learning environments that are aligned with how the human mind learns best.

For maximum comprehension and retention all lobes in both hemispheres of the brain should be involved in processing information. Sufficient reinforcement of the neural pathways of understanding is necessary for these pathways to become permanent and to enhance effective memory and learning. In reality, this does not always happen as described above. Drivers like brain fitness, sleep, stress, diet, skills, mind-set, movement and the physical environment can negatively (or positively) impact how people process information and how the brain learns.

Effective and successful people have accurate awareness of their learning preferences. They manage their neuro-design and the drivers that optimize it, so they can get what they want and become whom they can be.

It is unfathomable that those responsible for the preparation of our future teachers, to not ensure that they use and apply the latest research of current and future teaching strategies. The pool of research in the field of neuroscience is ever, continuing and rapidly expanding. Imagine graduates having a firm and foundational knowledge in this field and the application and implementation thereof during learning transfer. Enjoyment of the fruit of this expanding pool of research towards the improvement of student's future is the reward that they can enjoy and benefit from. This is an exciting and fascinating challenge to meet at a pivotal time in the evolution of education.

This includes insuring that the teachers who graduate have foundational neuroscience knowledge to use the fruits of the expanding pool of research to the betterment of all future learners.

Marinus Bell graduated at the Cape University of Technology and has lived out his passion with regards to education and development of all people. He enjoyed a very rewarding career as a mathematics teacher for 10 years after which he entered the world of property development. His entrepreneurial skills in the world of property development and educational knowledge and skills serve him well in his career as an educational consultant and workplace learning specialist. Marinus is the programme director for the African development arm of Neuro-Link, a boutique company that specialises in the Neuroscience of workplace learning. His passion is to help optimise the performance of all people, using brain based technologies foundational to all his interventions. He is a seasoned motivational speaker and trainer, a neuroscience coach and a regular host on radio and television talk shows with regards to people development.