Sabbatical Report for Term 3 2013.

The focus for this sabbatical was to explore current neuro-science evidence for adolescent brain development and the impacts that this might have for classroom practice. To achieve this I used both primary and secondary sources. Some of the findings have been included below.

Meeting with Nathan Mikaere-Wallis

This was an opportunity to speak with this neuro-scientist who has done a great deal of research on the adolescent brain. My intention from this interview was to develop a deeper understanding of how adolescents learn, from a neuro-science perspective and hopefully translate this into some suggestions for teacher practice.

Nathan touched on the development of Nurture groups which are being trialled in the UK currently. These groups are based on the concept of a home-room but with the difference that there is an attempt to recreate a normal family environment in the classroom which is something the students involved have missed out on.

The nuture group involves a small group of students with a teacher and teacher aide preferably a male and a female. The focus is on a social and emotional curriculum rather that and academic curriculum. I noticed that this concept had been incorporated into North Light school, a school for difficult students that I visited in September 2013 and later returned to deliver a lesson to two classes.

He talked about some recent research on executive function which is used to control impulse function.
Executive functions underpin all higher intelligence. There are many executive functions but 4 key ones have been identified:

Self-regulation
Meta cognition
Working memory
Cognitive flexibility

Executive function is a set of mental processes that helps connect past experience with present action. People use it to perform activities such as planning, organizing, strategizing, paying attention to and remembering details, and managing time and space.

If you have trouble with executive function, these things are more difficult to do. You may also show a weakness with working memory, which is like “seeing in your mind’s eye.” This is an important tool in guiding your actions.

As with other learning disabilities, problems with executive function can run in families. It can be seen at any age, but it tends to become more apparent as children move through the early elementary grades. This is when the demands of completing schoolwork independently can trigger signs of a problem with executive function.

Working Memory

The brain continues to mature and develop connections well into adulthood. A person’s executive function abilities are shaped by both physical changes in the brain and by life

experiences, in the classroom and in the world at large. Early attention to developing efficient skills in this area can be very helpful. As a rule, it helps to give direct instruction, frequent reassurance and explicit feedback.

Clarity of task linked to the learning outcome, positive encouraging comments, and clear well-constructed feedback and feed forward are essential components of working memory. A clear well-articulated learning outcome or intention appears to be essential to help students who are struggling with elements of executive function. They need to know what they are doing, why they are doing it and how it links to what they have done.

How Does Executive Function Affect Learning?

In school, at home or in the workplace, we're called on all day, every day, to self-regulate behaviour. Executive function allows us to:

- Make plans
- Keep track of time and finish work on time
- Keep track of more than one thing at once
- Meaningfully include past knowledge in discussions
- Evaluate ideas and reflect on our work
- Change our minds and make mid-course corrections while thinking, reading and writing
- Ask for help or seek more information when we need it
- Engage in group dynamics
- Wait to speak until we're called on

What Are the Warning Signs of Executive Function Problems?

A student may have problems with executive function when he or she has trouble:

- Planning projects
- Comprehending how much time a project will take to complete
- Telling stories (verbally or in writing), struggling to communicate details in an organized, sequential manner
- Memorizing and retrieving information from memory
- Initiating activities or tasks, or generating ideas independently
- Retaining information while doing something with it, for example, remembering a phone number while dialling

How Are Problems With Executive Function Identified?

There is no single test or even battery of tests that identifies all of the different features of executive function. Educators, psychologists, speech-language pathologists and others use a variety of tests to identify problems. Careful observation and trial teaching are invaluable in identifying and better understanding weaknesses in this area.

What Are Some Strategies to Help?

There are many effective strategies to help with the problem of executive function challenges. Here are some methods to try:

General Strategies

- Take step-by-step approaches to work; rely on visual organizational aids.
- Use tools like time organizers, computers or watches with alarms.
- Prepare visual schedules and review them several times a day.
- Ask for written directions with oral instructions whenever possible.
- Plan and structure transition times and shifts in activities.

Managing Time

- Create checklists and “to do” lists, estimating how long tasks will take.
- Break long assignments into chunks and assign time frames for completing each chunk.
- Use visual calendars at to keep track of long term assignments, due dates, chores and activities.
- Use management software such as the Franklin Day Planner, Palm Pilot or Lotus Organizer.
- Be sure to write the due date on top of each assignment.
- Students are very tech savy and using MLE’s to communicate deadlines and homework assignments to students via SMS or email may be an advantage for those students struggling with elements of executive function

Managing Space and Materials

- Organize work space.
- Minimize clutter.
- Consider having separate work areas with complete sets of supplies for different activities.
- Schedule a weekly time to clean and organize the work space.

Managing Work

- Make a checklist for getting through assignments. For example, a student’s checklist could include such items as: get out pencil and paper; put name on paper; put due date on paper; read directions; etc.
- Meet with a teacher or supervisor on a regular basis to review work; troubleshoot problems.

Other factors associated with Executive Function

- It is essential to explore working memory and develop strategies to improve this. Girls working memory usually develops earlier than boys which is why they can cope with literacy acquisition faster than boys. There are several organisations that have been experimenting with strategies to grow working memory.

- The concept of brain frequency is not new but something we often overlook in the classroom. Regular brain breaks, low anxiety classrooms with regulated noise

levels are essential to bring the brain frequencies down from the Beta levels into Alpha to engage the subconscious brain. The cerebellum needs steady rhythmic patterning to function effectively and the use of the appropriate music in the classroom coupled with some breathing exercises and brain gym can help with this.

- Brain is a survival tool geared for interaction, when all other needs are being met then learning will take place see maslows hierarchy of needs

- The prefrontal cortex is the home of metacognition

The Value of Music for Learning

Kids who learn a musical instrument at the age of 7 tend to develop a thicker corpus collosum which helps with emotional intelligence in later life.

Now a data-driven review by North-western University researchers that will be published July 20 in *Nature Reviews Neuroscience* pulls together converging research from the scientific literature linking musical training to learning that spills over to skills including language, speech, memory, attention and even vocal emotion. The science covered comes from labs all over the world, from scientists of varying scientific philosophies, using a wide range of research methods.
The explosion of research in recent years focusing on the effects of music training on the nervous system, including the studies in the review, have strong implications for education, said Nina Kraus, lead author of the Nature perspective, the Hugh Knowles Professor of Communication Sciences and Neurobiology and director of North western's Auditory Neuroscience Laboratory.
Scientists use the term neuroplasticity to describe the brain's ability to adapt and change as a result of training and experience over the course of a person's life. The studies covered in the Northwestern review offer a model of neuroplasticity, Kraus said. The research strongly suggests that the neural connections made during musical training also prime the brain for other aspects of human communication.
An active engagement with musical sounds not only enhances neuroplasticity, she said, but also enables the nervous system to provide the stable scaffolding of meaningful patterns so important to learning.
"The brain is unable to process all of the available sensory information from second to second, and thus must selectively enhance what is relevant," Kraus said. Playing an instrument primes the brain to choose what is relevant in a complex process that may involve reading or remembering a score, timing issues and coordination with other musicians.
"A musician's brain selectively enhances information-bearing elements in sound," Kraus said. "In a beautiful interrelationship between sensory and cognitive processes, the nervous system makes associations between complex sounds and what they mean." The efficient sound-to-meaning connections are important not only for music but for other aspects of communication, she said.
The Nature article reviews literature showing, for example, that musicians are more successful than non-musicians in learning to incorporate sound patterns for a new language into words. Children who are musically trained show stronger neural activation to pitch changes in speech and have a better vocabulary and reading ability than children who did not receive music training.
And musicians trained to hear sounds embedded in a rich network of melodies and harmonies are primed to understand speech in a noisy background. They exhibit both

enhanced cognitive and sensory abilities that give them a distinct advantage for processing speech in challenging listening environments compared with non-musicians. Children with learning disorders are particularly vulnerable to the deleterious effects of background noise, according to the article. "Music training seems to strengthen the same neural processes that often are deficient in individuals with developmental dyslexia or who have difficulty hearing speech in noise."
Currently what is known about the benefits of music training on sensory processing beyond that involved in musical performance is largely derived from studying those who are fortunate enough to afford such training, Kraus said.
The research review, the North-western researchers conclude, argues for serious investing of resources in music training in schools accompanied with rigorous examinations of the effects of such instruction on listening, learning, memory, attention and literacy skills.
"The effect of music training suggests that, akin to physical exercise and its impact on body fitness, music is a resource that tones the brain for auditory fitness and thus requires society to re-examine the role of music in shaping individual development, " the researchers conclude.

It is a good idea to explore working memory and develop strategies to improve this. Girls working memory usually develops earlier than boys which is why they can cope with literacy acquisition faster than boys. A company called luminosity has been experimenting with developing strategies to grow working memory.

Cerebellum needs steady rhythmic patterning, music in the classroom and breathing can help with this.

Brain is a survival tool geared for interaction, when all other needs are being met then learning will take place see Maslow’s hierarchy of needs

Paralymbic system

The emotional brain in males is not developed until the age of about 32 however males that learn a musical instrument display a greater level of emotional intelligence

The amygdala is 20-30% larger in males compared with females

The Effects of Exercise on the Brain

MK McGovern

Exercise has been touted to do everything from treat depression to improve memory, with the power to cure a host of problems while preventing even more. In particular, exercise leads to the release of certain neurotransmitters in the brain that alleviate pain, both physical and mental. Additionally, it is one of the few ways scientists have found to generate new neurons. Much of the research done in this area has focused on running, but all types of aerobic exercise provide benefits. Although the exact nature of these benefits is still being determined, enough research has been done to provide even skeptics with a

motivation to take up exercise. Exercise exerts its effects on the brain through several mechanisms, including neurogenesis, mood enhancement, and endorphin release. This paper not only examines how these mechanisms improve cognitive functioning and elevate mood states, but also proposes potential directions for future research. Furthermore, it provides an explanation for exercise's generally non-habit forming nature, despite effects on the reward centers of the brain that mimic those of highly addictive drugs like morphine.

One of the most exciting changes that exercise causes is neurogenesis, or the creation of new neurons. The new neurons are created in the hippocampus, the center of learning and memory in the brain (1), however the exact mechanism behind this neurogenesis is still being explored. At a cellular level, it is possible that the mild stress generated by exercise stimulates an influx of calcium, which activates transcription factors in existing hippocampus neurons. The transcription factors initiate the expression of the BDNF (Brain-Derived Neurotrophic Factor) gene, creating BDNF proteins that act to promote neurogenesis (17). Thus the generation of BDNF is a protective response to stress, and BDNF acts not only to generate new neurons, but also to protect existing neurons and to promote synaptic plasticity (the efficiency of signal transmission across the synaptic cleft between neurons, generally considered the basis of learning and memory) (1, 3, 17). However, BDNF's effects are more than protective, they are reparative. For example, in a comparison between sedentary and active mice, scientists found that active mice regenerated more sciatic axons post-injury than sedentary mice. This effect was not observed when the active mice were injected with a neurotrophin-blocking agent, indicating that exercise stimulates injured neurons to regenerate axons via neurotrophin-signaling mechanisms (3).

This reparative effect is particularly relevant to humans because the brain starts to lose nerve tissue beginning at age 30. Aerobic exercise reinforces neural connections by increasing the number of dendrite connections between neurons, creating a denser network, which is then better able to process and store information (4). This suggests possible preventative and therapeutic effects for diseases such as Alzheimer's and Parkinson's that progress via the loss of neurons. Indeed, a correlation between lifestyle and Alzheimer's has already been demonstrated (6). In addition, exercise has been shown to decrease the loss of dopamine-containing neurons in mice with Parkinson's (2).

There is a limit to the positive effects of neurotrophic factors, however. Mice bred to over exercise actually showed an inability to learn. A possible cause for this inability is the disruption of cognitive function by a preoccupation with exercise. The over exercising mice had elevated BDNF and neurogenesis, but the levels reached a plateau that did not increase with more exercise (14). This limitation is further illustrated by a study of exercise effects on a group of 60- to 75-year-olds versus a group of 18- to 24-year-olds. Sedentary 60- to 75-year-olds who began aerobic exercise demonstrated an improvement in executive cognitive functions, e.g. planning, scheduling, and working memory, while the group of 18- 24-year-olds did not. Brain-wave analysis showed a 35-millisecond faster brain response time post-exercise versus pre-exercise in the 18- to 24-year-olds. Essentially, less cognitive function was lost in 18- to 24-year-olds than in 60- to 75-year-olds, so there is less room for improvement, and that improvement will be less obvious (4). Apparently it is not possible to exercise to brilliance.

Fortunately, it may be possible to exercise to happiness. It has been shown that physically

active people recover from mild depression more quickly, and physical activity is strongly correlated with good mental health as people age (7). Depression is related to low levels of certain neurotransmitters like serotonin and norepinephrine. Exercise increases concentrations of these neurotransmitters by stimulating the sympathetic nervous system (12). In addition, serotonin has a reciprocal relationship with BDNF, i.e. BDNF boosts serotonin production and serotonergic signaling stimulates BDNF expression (17). Since exercise also increases BDNF production directly, there is a reinforcement of the serotonin-BDNF loop, indicating exercise's significant potential as a mood-enhancer.

In fact, a combination of exercise and antidepressants (which increase BDNF via the serotonin-BDNF loop) has been particularly effective in treating depressive behaviours in rats. The BDNF gene can be expressed in multiple forms, and physical activity increases the expression of two forms: one with fast but short anti-depressive effects, and one with slow but longer anti-depressive effects. By combining exercise with antidepressants (which increase the expression of the long-lasting form), scientists were able to both increase and accelerate the production of BDNF. The rats showed a decrease in depressive behaviours in two days instead of the two weeks experienced by those given antidepressants alone, indicating a potential therapy for depressed patients that produces almost immediate results (13).

There also seems to be a role for neurogenesis in the treatment of depression. Studies show that the hippocampus of depressed women can be up to 15% smaller than normal. In addition, there is a correlation between the decrease in size and the length of the depression. This damage may be reversed by BDNF-stimulated neurogenesis. Interestingly, the time it took for antidepressants to take effect is equal to the time needed to induce neurogenesis (16). All of these facts seem to point back to BDNF as the key chemical underlying exercise's impact on the brain. Perhaps it is not exercise that has the curative power, but rather BDNF, and exercise is only the trigger.

Another factor to consider is endorphins, the chemicals released by the pituitary gland in response to stress or pain. They bind to opioid receptors in neurons, blocking the release of neurotransmitters and thus interfering with the transmission of pain impulses to the brain (12). Exercise stimulates the release of endorphins within approximately 30 minutes from the start of activity. These endorphins tend to minimize the discomfort of exercise and are even associated with a feeling of euphoria. There is some uncertainty around the cause of this euphoria since it's not clear if endorphins are directly responsible for it, or if they just block pain and allow the pleasure associated with neurotransmitters such as serotonin and dopamine to be more apparent. If the latter is true, this would indicate a connection to BDNF via the serotonin-BDNF loop. In this case, BDNF is again the underlying chemical providing the benefits of exercise, and endorphins act in a supporting role by blocking pain and reducing the cost associated with acquiring the benefits of exercise. The release of endorphins has an addictive effect, and more exercise is needed to achieve the same level of euphoria over time. In fact, endorphins attach to the same neuron receptors as opiates such as morphine and heroin (12). Yet, exercise is not nearly as addictive as these opiates; it's not even as addictive as milder substances such as nicotine. It seems strange that an activity as beneficial as exercise, with a built-in mechanism for addiction, is so easy to give up. According to some polls, only about 15% of Americans say they exercise regularly (18).

The release of BDNF from even mild forms of exercise could be a key factor in increasing student engagement in the classroom.

A short stretch or the use of brain gym every 20 minutes or perhaps twice in a one hour lesson could be a valuable method of helping students struggling with focus.

The Multiple Intelligences

In 1983 Howard Gardner, psychology professor at Harvard University, presented his Multiple Intelligence theory based upon many years of research. Promoting the concept that intelligence is not one entity but that there are many different forms of intelligence, Gardner has awakened a revolution in learning. Multiple Intelligence teaching methods recognize eight (though there may be more) forms of intelligence: visual-spatial, linguistic, logical-mathematical, bodily-kinesthetic, interpersonal, intrapersonal, musical, and most recently naturalist. Multiple Intelligence teachers strive to broaden students familiarity and skill levels in each area.

The Multiple Intelligence teaching model emphasizes education for understanding rather than rote memory or the mimicking of skills. Practical hands-on skill development is coupled with factual knowledge and the ability to apply skills and information in real-life situations and make meaningful contributions to society.

Development of the musical intelligence can be greatly aided by the use of music throughout the curriculum. In addition to learning about musical elements and how to create music, the musical intelligence involves developing an ability to respond to musical sound and the ability to use music effectively in one's life. As a musician who has taught general music in public and private schools I can speak to the value of having students hear music throughout the school day as a means of increasing musical intelligence. The more students listen and respond to a variety of music, the more they will know about music on a personal, real-experience level, the deeper will be their understanding of why people throughout time and around the world create music, the greater will be their ability to use music productively in their lives, and the more eager they will be to develop their musical skills because they will understand, appreciate and enjoy music more!

School Visits in Singapore

North Light School.

This school was an experimental school established by the MOE in 2007 to provide an education opportunity to those students who were slipping through the cracks. These are students who have not achieved their primary equivalency exam and are struggling at school. In the past these students have tended to drop out of school and alternately end up with no formal qualifications.

The school is very well resourced and has a range of practical subjects such as engineering, woodwork, retailing, and food preparation. The school also has a model hotel room to teach hospitality services. They have clearly identified that these students are not academic and therefore they need to provide alternative options for them.

The school was given a mandate by the government to establish an alternative curriculum designed to meet the needs of these student's. The curriculum is very heavily focussed on the personal develop of the students which they call character education together with a literacy and numeracy focus. The staff are expected to create a positive atmosphere in the classroom and where possible they tend to use a restorative approach to classroom discipline. It is interesting to note that caning is still used in Singaporean schools and indeed is incorporated into the fabric of the law. It is reserved for repeat offenders or more serious offences

Kinaesthetic activities feature strongly in the curriculum and teachers are encouraged to differentiate the curriculum to meet the learning needs of a diverse group of students. Literacy levels can be very low so additional literacy support is provided for those who need it. These students come from difficult backgrounds and as a result bring with them some severe emotional problems. As a consequence 4 counsellors are employed for the 800 students, one for each of the four levels and they will move up with the year groups.

The students start the day with a half hour form time or home room time. These are set up to try and mirror a positive home environment so developing positive relationships are a key focus for this time.

The classrooms are structured to include a quiet area for students who are feeling unsettled can withdraw themselves for reflection for a time period determined by the student before returning to the lesson.

All students are encouraged to complete a programme for Information and Communication Technology and gain a qualification in this area. In fact for most of the students this will be the only qualification the students will gain. IGCSE and A level qualifications which are the main qualification for the state run MOE schools are not offered. Students can return t the state system if they pass the PSLE entry qualification.

All students participate in a Sports and Wellness Programme throughout their time at North Light. Physical Activity is seen as a significant part of the student's education and this is supported by current research regarding the release of BDNF in the brain.

Music and dance are also incorporated in the programme for all students and this also supports the movement for learning concept. The Orff-Schulwerk approach is used:

The Orff Approach of music education uses very rudimentary forms of everyday activity for the purpose of music creation by music students. The Orff Approach is a "child-centered way of learning" music education that treats music as a basic system like language and believes that just as every child can learn language without formal instruction so can every child learn music by a gentle and friendly approach. It is often called "Elemental Music making" because the materials needed to teach students are "simple, basic, natural, and close to a child's world of thought and fantasy".
In order for the Orff Approach to effectively work teachers must create an atmosphere that is similar to a child's world of play. This allows participating children to feel comfortable

learning a new and often abstract musical skill, greater exploration of a musical instrument or musical skill, and keeps a student from feeling evaluated or judged by his or her peers and teachers. A child participating in an Orff classroom does not feel the pressure of performing that is often in tandem with music because every student in an Orff classroom is treated as an equal, even when performing a solo. The Orff Approach is used by teachers to encourage their students to enjoy making music as individuals as well as in groups. Children realize the joys of group co-ordination and cohesion. It also involves the participation of other adults and parents in music making. Thus it brings the role of parent in child education in a central position. From a teacher's aspect Orff-Schulwerk is also a process of breaking down each activity into its simplest form and then presenting those steps one at a time to eventually become a completed performance.
In the Orff Approach "all concepts are learned by 'doing'". Students of the Orff Approach learn music by experiencing and participating in the different musical lessons and activities. These lessons stimulate not only the paraxial concepts of music like rhythm and tempo, but also the aesthetic qualities of music. "Orff activities awaken the child's total awareness" and "sensitize the child's awareness of space, time, form, line, color, design, and mood- aesthetic data that musicians are acutely aware of, yet find hard to explain to musical novices".
Unlike Simply Music or the Suzuki Method, the Orff-Schulwerk approach is not a method. There is no systematic stepwise procedure to be followed. There are fundamental principles, clear models and basic processes that all intuitive and creative teachers use to guide their organization of musical ideas.

I am currently employed in an international school in Singapore teaching Business studies and Economics to first year IGCSE students and establishing a thinking skills programme based on some of the principals mentioned in this document. This programme is run for all the year 1 students. The programme incorporates brain gym, breathing exercises, problem solving, and relaxation, visualisation as well as knowledge sections on diet exercise brain function.

The keys elements around executive function will also be explored with a focus on growing skills in working memory, organisation, planning and self-regulation.

The programme will evolve into an exploration into inquiry and innovation using some of De Bonos strategies and then incorporate entrepreneurial skills such as team work, goal setting, active listening and building confidence in self and others.

The year two the programme will offer students the opportunity to use these skills to analyse a problem then look at possible solutions and from this develop a product together with a business plan

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