Upstream Optimisation for 21st Century Education: The Potential Impact of Heartmath™ Systems on the Teacher-Learner

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Abstract

This paper explores the potentially positive impact of HeartMath coherence training on the current educational environment. This holistic modality may work upstream of the classroom experience by priming individuals to optimally function cognitively, physiologically, and emotionally before they arrive in the formal learning environment and after they leave. Such a sustainable mind-body approach could result in the prevention, minimisation, and/or alleviation of growing 21st century challenges in the classroom

KEY WORDS: *Holistic, HeartMath, coherence, heart-brain, cognitive resilience, emotional self-management*

Introduction

Philosophically, holism is defined as a "theory that parts of a whole are in intimate interconnection, such that they cannot exist independently of the whole, or cannot be understood without reference to the whole, which is thus regarded as greater than the sum of its parts" (Oxford dictionary online, 2nd edition).

At the dawn of the 21st century, the philosophy of holism has become more prevalent in the medical model, giving rise to the rebirth of the traditional practice of medicine which then became relabelled as what many refer to currently as alternative or complementary medicine. Inherent in the philosophy of holism lies the concept of interconnectedness which logically leads to the philosophy of holism being applied in varying degrees to parts of the whole societal construct, education included.

In general, a holistic educational environment is defined as one with a curriculum that "is inquiry-driven, interdisciplinary and integrated, and is based on explicit assumptions of interconnectedness and wholeness …" which deems learning as being "organised around relationships within and between learners and their environment while empowering learners" (Web, Holistic Education Network of Tasmania). Within this perspective, there lies an inextricable connection between teaching and learning and vice versa. For this reason, such a dynamic could be referred to as the teacher-learner and the events within the dynamic as teaching-learning.

Holistic educational practices consistently emphasised collaborative and cooperative learning (Rudge 2008; Forbes and Martin 2004). Also consistent with the interconnectedness principle inherent within holistic philosophy, both collaborative and cooperative learning positively influence the intrinsic motivation of the teacher-learner (Brecke & Jensen 2007).

Although the 21st century educational movement has brought forth many useful pedagogical and learning tools, there have also been tremendous challenges that have arisen concurrently. Twenty-first century children are exposed to more stressors than in the past, such as bullying, the threat of extreme violence, more adult responsibilities, and

the increase in prevalence of psychological challenges such as ADHD and autism Spectrum disorder (Bloomberg 2011). Yet, there is no focus on much needed emotional management within this rapidly changing terrain (McCraty 2015).

Finding viable ways to navigate the new 21st century terrain has become overwhelming due to the emergence of these emotional health challenges outpacing the emergence of the practical application and integration of research-based models to address them, especially during this time of economic instability. For these reasons, I propose that a research-based modality which is primarily focused on psycho-physio self-regulation entrainment be applied to optimise their readiness for teaching-learning. It is my position that combining the instalment of HeartMath coherence entrainment as a foundational aspect of the educational system can optimise the individual's readiness to teach-learn, thus preventing, minimising, and/or alleviating many current challenges whilst improving the potential for successful outcomes.

HeartMath Coherence

Heart-brain connection

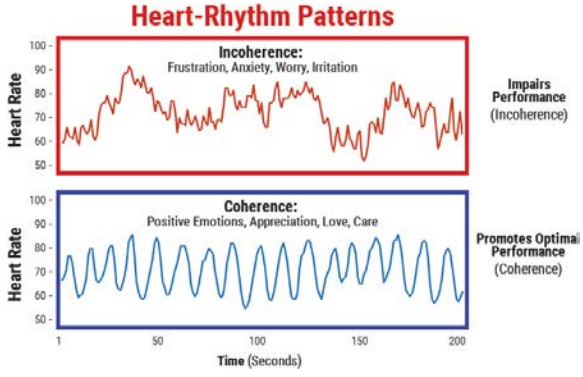
Research has shown that the heart has its own autonomous nervous system, referred to as the heart-brain, which encodes and processes information. What is fascinating about this finding is that the heart-brain actually sends more information to the brain than the brain sends to the heart (McCraty 2003; McCraty et al. 2014). The heart-brain also "makes decisions independent of the cerebral brain." Furthermore, the heart's electromagnetic field has been found to be 5000 times more powerful than the brain's. This is why the heart's state has a tremendous effect on the brain as evidenced by Electroencephalogram (EEG) pattern analysis (McCraty 2004).

Psychophysiological coherence as emotional management tool

Since positive emotions have been found to produce faster learning and improved intellectual performance, educating teacher-learners to practice effective emotional management techniques can play a significant role in optimising the 21st century learning environment (Fredrickson 2002).

A substantial body of evidence supports the view that our emotional state rapidly affects the heart's rhythm. When positive emotions such as appreciation or compassion are experienced, the heart rhythm configuration displays a smooth sine curve-like pattern which is distinctly different from relaxation; whereas, negative emotional states such as anger and frustration result in an erratic heart rhythm pattern upon analysis (Figure 1).

Figure 1: **Heart rhythm patterns of coherence and incoherence**



Notes: The coherent state has been correlated with a general sense of well-being and improvements in cognitive, social, and physical performance. We have observed this association between emotions and heart-rhythm patterns in studies conducted in both laboratory and natural settings and for both spontaneous and intentionally generated emotions (McCraty 2015).

Sources: Tiller, W.A., R. McCraty and M. Atkinson (1996) Cardiac coherence: A new, noninvasive measure of autonomic nervous system order. *Alternative Therapies in Health and Medicine* 2(1):52-65.
McCraty, R., W.A. Tiller and M. Atkinson (1995) The effects of emotions on short-term power spectrum analysis of heart rate variability. *American Journal of Cardiology* 76(14):1089-93.

Chaotic heart rhythm patterns indicate emotional incoherence, energy drainage, decrease in higher cognitive functions, and eventual erosion of the body. Conversely, smooth heart rhythm patterns are an indication of physiological coherence which is a state of optimal cognitive, physical, and emotional balance. The results from coherence patterning overtime is a symphony of resonance of all the combined body systems synchronously matching with the heart rhythm coherence pattern, resulting in their optimal functioning as well (McCraty and Zayas 2014).

Coherence-building tools

After over 20 years of scientific research, several heart-based tools and technologies for teaching and learning have been designed and employed by the Institute of HeartMath (Atkinson et al. 2009). These teaching-learning tools and technologies are geared at enabling students to systematically increase physiological coherence and emotional stability, thus optimising both academic performance and social-emotional well-being (Atkinson et al. 2009).

The whole collection of these tools and technologies are referred to as the 'HeartMath System'. Examples of HeartMath tools and techniques include the Neutral Tool™, Freeze-Frame Technique™, Heart Lock-In Technique™, TestEdge™ and Early HeartSmart™. A commonality amongst them is they use the heart to access the emotions. In this way, emotions can be self-regulated rapidly, profoundly, and constructively (McCrady 2004).

Thus, the EM-Wave™ biofeedback software has proven to be extremely effective in teaching emotional self-regulation required to achieve a physiologically coherent state. Heart rhythm feedback training is accomplished effectively using this software which also analyses the heart rhythm patterns for coherence level, which is instantly fed back to the trainee in real time. There are also video games as well as computer games designed to reinforce emotion-refocusing skills. The software also includes a user-friendly database to store results and track the progress of multiple trainees over time (McCrady 2004).

Endurance and re-patterning

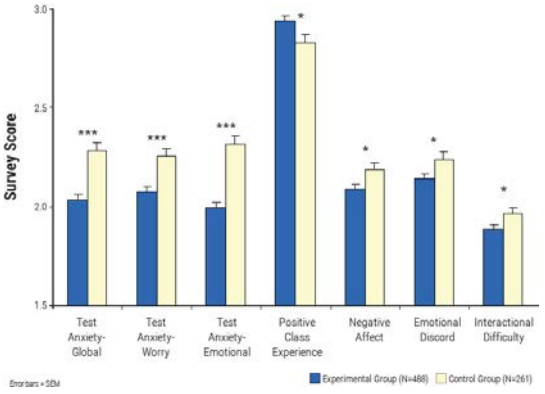
Once people learn to self-generate a physiological coherent state on a regular basis, a re-patterning occurs multi-systemically reforming the neurological terrain to match a coherent baseline. In this way physiological coherence becomes the new 'normal' state for individuals, and they spend more and more time in a coherent state without consciously needing to self-regulate (Atkinson et al. 2009). So, essentially baseline stress which acts as a 'silent killer' can be transformed over time into baseline coherence which acts as a 'silent vitaliser'

HeartMath Interventions

TestEdge National Demonstration Study (TENDS)

The purpose of the TENDS was to test the efficacy of TestEdge™ in reducing stress and test anxiety which increases emotional well-being and academic performance in public school students. The results showed a significant reduction in test anxiety accompanied by a significant improvement in emotional wellbeing. (Figure 2) Moreover, the test scores showed significant improvement compared to those of control groups (Arguelles et al. 2007; McCraty 2014).

Figure 2: **Results of an ANCOVA of pre- and post-intervention changes**



Notes: Results of an ANCOVA of pre- and post-intervention changes in measures of test anxiety (global scale, worry component, and emotionality component) and social and emotional scales (positive class experience, negative affect, emotional discord, and interactional difficulty) showing significant differences between the intervention and control schools. *p < 0.05, ***p < 0.001. (McCraty 2015)

Source: Arguelles, R.T.L., M. Atkinson, R.T. Bradley, A. Daugherty, R. McCraty and D. Tomasino (2010) Emotion self-regulation, psychophysiological coherence, and test anxiety: Results from an experiment using electrophysiological measures. *Appl Psychophysiol Biofeedback* 35(4):261-83.

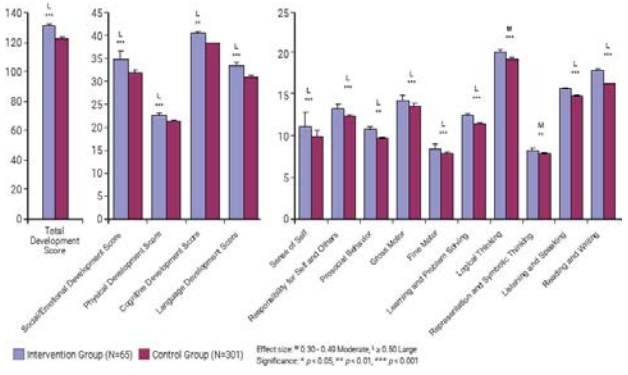
HeartMath benefits a wide range of demographics

A myriad of studies have shown improvement in well-being, behaviour and academic performance with the implementation of HeartMath tools in schools ranging from early school age to College (Atkinson et al. 2012). Moreover, HeartMath tools and technologies are created as basic, user-friendly, and cost-effective interventions that can be adjusted to virtually any cultural demographic, age group, or educational setting (Hayashino et al. 2010).

Preschool study

A programme Early HeartSmarts® (EHS) was specifically intended to help equip children aged 3 to 6 with the foundational emotion self-regulation and social competencies for learning. Classes in the intervention group were selected by the district to target children of lower socioeconomic and ethnic minority backgrounds (McCraty 2015). The findings showed large significance in developmental parameters compared to control as well as a developmental vigour which sometimes surpassed the control groups (Figure 3).

Figure 3: **Early HeartSmart (EHS) adjusted means**



Notes: Early HeartSmart (EHS) adjusted means showing results of ANCOVA of intervention effects on development measures of 3-6 year olds, comparing intervention and control groups

Source: McCraty (2015)

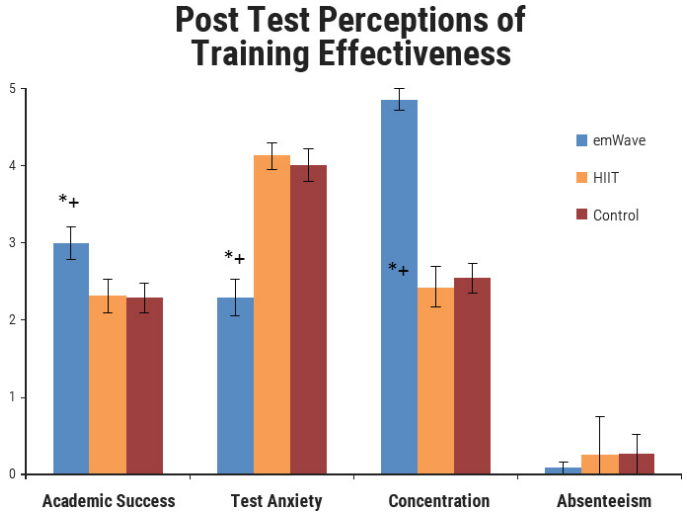
Critical interventions

Many successful HeartMath interventions for educational facilities have taken place in schools with prevalent, critical, academic, and/or socio-behavioural crises which needed to be immediately addressed. For example, a HeartMath intervention carried out at a Preparatory College resulted in a steady increase from 12 to 75 per cent improvement in standardised math scores over a three year period (Leslie and Vislocky 2005). Most of these schools are located in critically stressful and violent communities (Arguilles et al. 2007).

College studies

Culturally diverse groups of college students showed significant reduction in anxiety when HeartMath biofeedback tools were combined with counselling compared to counselling alone (Hayashino et al. 2012). A study at Florida State University demonstrated a significant reduction in test anxiety and absenteeism combined with significant increases in concentration and academic scores (McCraty 2014). Dr. Ross May et al. (2014) from Florida State University found that the psychophysiological functioning underlying school burnout is of particular importance and is associated with increased markers of cardiovascular risk and poor academic performance using the Grade Point Average (GPA) as an index. They also demonstrated that school burnout is a stronger predictor of GPA than it is a predictor for anxiety and depression (McCraty 2015). Figure 4 shows the impact of HeartMath training on College Student 'Burnout' compared to alternate self-management techniques such as a High Intensity Interval Training (HIIT) exercise programme.

***Figure 4:* Data for three groups for academic success, test anxiety, concentration, and absenteeism**



Notes: Data for three groups for academic success, test anxiety, concentration, and absenteeism from classes over the semester. Data are mean and 95% CI. * = $p < .05$ HeartMath vs. HIIT post-test, + = $p < .05$ HeartMath vs. Control, a = $p < .05$ HeartMath pre-test vs. HeartMath post-test, b = $p < .05$ HIIT pretest vs. HIIT post-test, c = $p < .05$ Control pre-test vs. Control post-test.

Source: McCraty (2015)

Professional school study

In the professional school setting, recent studies assessing nursing students as they entered the most demanding portion of their curriculum showed that HeartMath training significantly reduced their anxiety levels compared to control groups (Kathalae et al. 2012).

In 2003, Oklahoma University nursing school introduced HeartMath into their nursing program in order to address the high attrition rates of Native American nursing students. After five years of implementing HeartMath self-management, the attrition rate of Native American nursing students decreased by 40 per cent and the overall attrition decreased by 63 per cent (McCraty 2014).

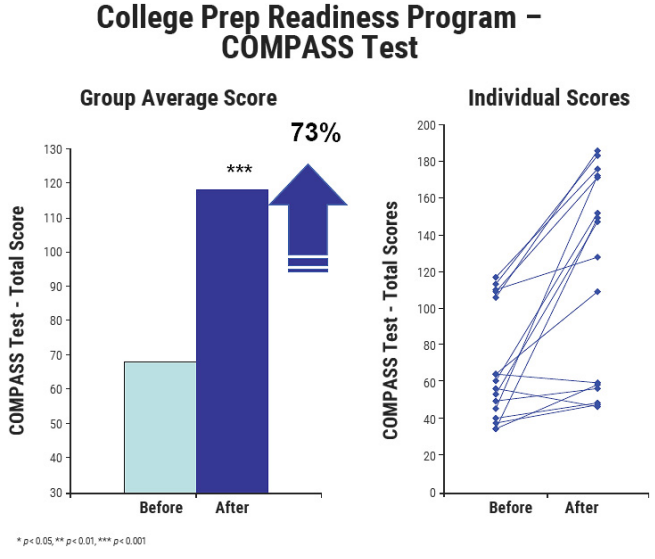
Special needs study

Scientific Investigations evaluating the impact of HeartMath coherence training on children with ADHD also found a "significant improvement in various aspects of cognitive functioning such as delayed word recall, immediate word recall, word recognition, and episodic secondary memory. Significant improvements in behaviour were also found" (Bret et al. 2010).

College readiness

At the University of Cincinnati Clermont College (UCCC) as many as 92 per cent of incoming first-year college students were scoring below standard for college-level mathematics (McCraty 2015). After integrating HeartMath's self-regulation techniques and heart-rhythm coherence feedback technology into their college readiness programmes in math, a reduction was found in high school students' anxiety related to learning maths and taking high-stakes tests as well as improve students' learning, comprehension, and retention. Figure 5 shows the 73 per cent improvement in maths test scores after only seven weeks of HeartMath coherence training.

Figure 5: **Average and individual student improvements in scores on the Compass college placement test**



Notes: Average and individual student improvements in scores on the Compass college placement test in algebra before and seven weeks after learning and using the HeartMath self-regulation skills and HRV coherence technology as an integral part of maths instruction. Results show a statistically significant ($p < 0.001$) average increase of 73% in student scores on the college placement test.

Source: McCraty (2015)

Resilient Educator

Effective implementation of HeartMath coherence training in educational settings has always involved HeartMath Coherence training of the educator and HeartMath Resilient Educator™ certification (Arguilles et al. 2003; McCraty 2004) by observing coherence patterns with more than one person present, researchers have demonstrated that a coherent heart pattern can influence the EEG of other people who are in close proximity (McCraty 2004; Atkinson et al. 2009). This is significant in terms of the subtler elements of the educational environment and classroom management. It makes sense that resilient and coherent teachers influence the coherence and resilience of learners, and vice versa. Resilient educators can also act as facilitators for the implementation of HeartMath coherence training.

Is HeartMath Feasible in Bermuda's Schools?

Need and cost

The study on college readiness demonstrated that the need for remedial maths diminished and the college placement maths score increased by 73 per cent after seven weeks of HeartMath intervention is a feasible pilot study for Bermuda. The study found that scores increased as time went on and that the school in question had fully implemented HeartMath Systems in four years. Bermuda College has a College Placement Test (CPT) which places students in specific Math, English, and Reading courses. Like community and state colleges in the United States, Bermuda College also has over 85 per cent of entry level students scoring below college level standards so the need for intervention is clear. The educational division of HeartMath is non-profit, so that the hardware, software, and other materials of the HeartMath system are available at low cost.

Versatility

There is a very large body of evidence demonstrating that HeartMath tools can be applied to any context requiring stress management. HeartMath has been successfully applied to professional sports, corporations, and healthcare.

Cultural empathy

No concerns of cultural bias have been reported, but cultural empathy was noted as a pleasant side effect by high-risk study participants.

Logistics

Researchers have identified several key influences on the success of HeartMath implementation in school systems. These include teacher/facilitator commitment, high expectations, in-class emotional management, continuous feedback on progress, and commencing at the beginning of term. It was also found that students benefitted most when given ample opportunities to apply HeartMath tools inside and outside the classroom.

Vislocky and Leslie (2005) has published the first work showing that the application of the HeartMath System of self-regulation tools directly to the mathematics learning environment may be effective in enhancing student learning and academic performance whilst better preparing secondary students for tertiary education.

Conclusion

The HeartMath Institute offers a versatile, cost-effective, user-friendly, and empowering system for optimising readiness for teaching-learning environments. What makes the system particularly viable for upstream optimisation of classroom readiness is that its style of emotional self-regulation can be consistently and effectively learned in a short time by people as young as three years old. Furthermore, successful application of these tools can lead

to improved physical health and well-being whilst potentially preventing, managing, and/or minimising modern emotional stresses and psychological challenges. Better still, the applications of this system do not end in the classroom but rather are structured to bring about a lifestyle change. Coherent heart states held by some propagate coherent brain and heart states in others in the vicinity. In fact, The Institute of Heart Math is working on a Global Coherence Project with the goal of global harmonisation (McCraty 2015).

The implementation of HeartMath Systems in Bermuda's educational system is a viable option worthy of investigation. Moreover, if the effect of such introduction in Bermuda is consistent with the 20-plus years of research elsewhere, the country could experience a rapid and positive transformation not only in the educational system, but also in the community at large.

References

Arguelles, L., R. McCraty and R. Rees (2003). The heart in holistic education. *Encounter: Education for Meaning and Social Justice* 16(3):13-21.

Arguelles, L., M. Atkinson, R.T. Bradley, A. Daugherty, R. McCraty and D. Tomasino (2010). Emotion self -regulation, psychophysiological coherence, and test anxiety: Results from an experiment using electrophysiological measures. *Applied Psychophysiology and Biofeedback* 35(4):261-83.

Arguelles, L., M. Atkinson, R.T. Bradley, R. McCraty, R.A. Rees and D. Tomasino (2007). Reducing test anxiety and improving test performance in America's schools: Summary of results from the TestEdge national demonstration study. *HeartMath Research Center, Institute of HeartMath*, Publication No. 00-010. Boulder Creek CA.

Atkinson, M., R.T. Bradley, P. Gavin and D. Tomasino (2012). Efficacy of an emotional self-regulation program for promoting development in preschool children. *Global Advances in Health and Medicine* 1(1):36-50.

Atkinson, M., R.T. Bradley, R. McCraty and D. Tomasino (2009). The coherent heart, heart–brain interactions, psychophysiological coherence, and the emergence of system-wide order. *Integral Review* 5(2):10-115.

Atkinson, M., J. Goelitz, H.N. Mayrovitz, R. McCraty and D. Tomasino (1999). The impact of an emotional self-management skills course on psychosocial functioning and autonomic recovery to stress in middle school children. *Integrative Physiological and Behavioral Science* 34(4):246-68.

Backhed, F. and F. Sommer (2013). The gut microbiota-masters of host development and physiology. *Nature Reviews Microbiology* 11:227-38.

Bercick, O. and S.M. Collins (2009). The relationship between intestinal microbiota and the central nervous system in normal gastrointestinal function and disease. *Gastroenterology* 136(6): 2003-14.

Bloomberg, S.J., S. Boulet, S. C. Boyle, R.A. Cohen, M.D. Kogan, L.A. Schieve, S. Visser and M. Yeargin-Allsopp (2011). Trends in the prevalence of developmental disabilities in US children, 1997-2008. *Pediatrics* 127(6):1034-42.

Borre, Y.E., G. Clarke, J.F. Cryan, T.G. Dinan, G.W. O'Keeffe and C. Stanton (2014). Microbiota and neurodevelopmental windows: Implications for brain disorders. *Trends in Molecular Medicine* 20(9):509-18.

Brett, D., A. Lloyd and K. Wesnes (2010). Coherence training in children with attention deficit hyperactivity disorder: Cognitive functions and behavioral changes. *Alternative Therapies in Health and Medicine* 15(4):34-42.

Brecke, R., and J. Jensen (2007). Cooperative learning, responsibility, ambiguity, controversy and support in motivating students. *Insight: A collection of faculty scholarship* 2:57-63.

Burkholder, P.R. and I. McVeigh (1942). Synthesis of vitamins by intestinal bacteria. *Botany* 28: 285-89.

Campbell-McBride, N., (2010). *Gut and psychology syndrome: Natural treatment for dyspraxia, autism, dyslexia, ADD, ADHD, depression, schizophrenia*. UK: Medinform.

Cani, P.D. and N.M. Delzenne. (2009). *The role of the gut microbiota in energy metabolism and metabolic disease. Current Pharmaceutical Design* 15(13):1546-58.

Cryan, J.F. and T.G. Dinan (2012). Mind-altering microorganisms: The impact of the gut microbiota on brain and behavior. *Nature Reviews Neuroscience* 13:701-12.

Forbes, S.H. and R.A. Martin (2004). What holistic education claims about itself: An analysis of holistic schools' literature. *American Education Research Association Annual Conference.*

Foster, J.A. and K. McVey Neufield (2013). Gut-brain axis: How the microbiome influences anxiety and depression. *Trends in Neuroscience* 36(5):305-12.

Fredrickson, B.L. (2002). Positive emotions. In C.R. Snyder and S.J. Lopez (eds), *Handbook of Positive Psychology.* New York: Oxford University Press, pp.120-34.

Garner, T. and J.R. Malagalada (2003). Gut flora in health and disease. *The Lancet* 935(361):512-19.

Hayashino, D., J. Prince, P. Ratanasirpong and K. Sverduk (2012). Biofeedback and counseling for stress and anxiety among college students. *Journal of College Student Development* 53(5):742-49.

Hayashino, D., J. Prince, P. Ratanasiripong and K. Sverduk (2010). Setting up the next generation biofeedback program for stress and anxiety management for college students: A simple and cost-effective approach. *College Student Journal* 44:97-100.

Kathalae, D., N. Ratanasiripon and P. Ratanasiripong (2012). Biofeedback intervention for stress and anxiety among nursing students: A randomized controlled trial. *International Scholarly Research Network* 2012:1-5.

Lee, A. (2009). Health-promoting schools: Evidence for a holistic approach to promoting health and improving health literacy. *Applied Health Economics and Health Policy* 7(1):7-11.

Leslie, R.P. and M. Vislocky (2005). Efficacy and implementation of HeartMath instruction in college readiness program: Improving students' mathematics performance and learning. University of Cincinati Clearmont College. http://mathematics.clc.uc.edu/Vislocky/CPR%20Project.htm. Consulted on 4 November 2015.

May, R.W., M.A. Sanchez-Gonzalez, and F.D. Fincham (2014). School burnout: Increased sympathetic vasomotor tone and attenuated ambulatory diurnal blood pressure variability in young adult women. *Stress* (0):1-9.

May, R.W., K.N. Bauer, and F.D. Fincham (under review). School Burnout: Diminished Academic and Cognitive Performance. Learning and Individual Differences.

Mazmanian, S.K. and J. Round (2009). The gut microbiota shapes intestinal immune responses during health and disease. *Nature Reviews Immunology* 9:313-23.

McCraty, R. (2003). Heart-brain neurodynamics: The making of emotions. *In Issues of the Heart: The Neuropsychotherapist special issue,* 76-110.

McCraty, R., (2004). The energetic heart: Bioelectromagnetic communication within and between people. *Clinical Applications of Bioelectromagnetic Medicine*, pp.541-62.

McCraty, R. (2015). Science of the heart: Exploring the role of the heart in human performance: An Overview of Research Conducted by the HeartMath Institute. Volume 2. https://www.heartmath.org/research/science-of-the-heart/outcome-studies-in-education/ Consulted on 15 April 2016.

McCraty, R., and M.A. Zayas (2014). Cardiac coherence, self-regulation, autonomic stability, and psychosocial well-being. *Frontiers in Psychology* 1090(5):1-13.

McCraty, R, F. Shaffer and C. Zerr (2014). A healthy heart is not a metronome: An integrative review of the heart's anatomy and heart rate variability. *Frontiers in Psychology* 1040 (5):1-19.

Rudge, L.T. (2008). Holistic education: An analysis of its pedagogical application. (PhD diss., Ohio State University). https://etd.ohiolink.edu/!etd.send_file?accession=osu1213289333&disposition=inline. Consulted on 1 November 2015.

Watts, M.K. (2011). Nutritional therapy in practice for learning, behavioural and mood disorders. *Nutrition and Health* 20:239-59.

Web. Holistic Education Network of Tasmania, Australia taken from http://www.hent.org/intro2.htm. Consulted on 1 November 2015.