Literature Synopsis:

Brain-based Learning

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Introduction

Effective teachers never stop exploring different ways to improve student achievement. As there is no single, perfect solution, educators look to research to guide their practice. Recent innovations in science have allowed an unprecedented look into the way the brain works. The exciting learnings about brain function and its effects on learning have the potential to revolutionize teaching and learning.
Brain research has provided new knowledge about the many ways that humans learn. Brain-based *learning* has resulted from educators and researchers applying the findings of brain research to guide teaching practice. The last decade has seen more systematic implementation of brain-based strategies that emphasize emotion, thematic instruction, differentiated learning, movement, and the use of mental models. As well, changing conceptions of memory, assessment, the learning environment, the biology of the brain, and uses of time have all served to improve student achievement. Brain-based teaching involves the implementation of carefully-designed principles with due consideration of their impact before, during, and after each lesson.

The never-ending search for better teaching practices in this area has led educators to the work of key authors such as Caine, Caine, McClintic, and Klimek (2005), Erlauer (2003), Jensen (2005), Slavkin (2004), Wagmeister and Shifrin (2000), and Wolfe (2001). Most of these authors would agree with those teachers who contend they already incorporate some aspects of brain-based learning into their classrooms. However, they would also suggest that the pathway to more effective implementation follows a process of continual research, or sustained inquiry, which involves collaboration, planning, action, evidence-gathering, and reflection on practice.

Key findings

1. Mental Models – enhance teacher practice

Teachers are challenged to reflect on their own mental models of what teaching and learning looks like in their classrooms before they can effectively begin to incorporate brain-based learning strategies. Caine and Caine (1995) believe that a change in mental models is equivalent to a change in teacher perception. Process groups can be one productive way for teachers to question their own and others' perspectives. Teachers can examine current literature and research and reflect on their own personal practice and beliefs before making changes to their professional practice (Caulfield, Kidd & Kocher, 2000; Caine, Caine, McClintic & Klimek, 2005; Winters, 2001). When teachers begin to take responsibility for their professional improvement, this will lead to changes in their mental models (Caine et al., 2005).

2. Emotions - impact on student learning

Students' emotional states influence their level of academic achievement. Caine, in an interview with Pool, stresses the importance of establishing a culture and environment where students feel safe and are not fearful (Pool, 1997). This is characterized by a state of *relaxed alertness* where students are not anxious about their surroundings but, rather, open and receptive to new information (Caine et al., 2005). Sylwester (in D'Arcangelo, 1998), says "…our emotional system drives our intentional system, which

drives learning and memory and everything else that we do. It is biologically impossible to learn and remember anything that we don't pay attention to" (p. 25). A positive emotional state is essential for the student's ability to acquire new knowledge, and helps focus the attention of the individual (Caine, 2000; Caine et al., 2005; Caulfield et al., 2000; D'Arcangelo, 2000; Pool, 1997; Slavkin, 2004; Wagmeister & Shifrin, 2000; Wolfe, 2001).

3. Learning Environment – shaping student achievement

Learning is enhanced when the environment accommodates the needs of the learner and the instructor. Reigeluth and Beatty (2003) support the notion that the student's "…whole environment, school, home, and other settings should be considered as part of the learning environment" (p. 27). Students need to understand the impact of a lack of sleep, food and water on their biology and how such things impact their brain's ability to learn (Erlauer, 2003; Slavkin, 2004). Students who can participate actively in teaching and learning in the classroom become more excited about their education (Goldberg & Stevens, 2001). Teachers can ensure that their classroom is a rich, stimulating environment, allowing students to become immersed in a complex milieu that stimulates the mind (Caine et al, 2005; Caulfield et al., 2000; Wagmeister & Shifrin, 2000; Wolfe, 2001). They can design a variety of teaching and learning activities that will access the brain's ability to remember visually and emotionally and encourage students to take risks (Caine et al., 2005; Caulfield et al., 2000; Saunders & Vawdrey, 2002; Wagmeister & Shifrin, 2000; Wolfe, 2001).

4. Memory – can't forget it!

Brain research has discovered multiple memory systems applicable to student learning. Tileston (2005) refers to long-term memory as "…a five-drawer file cabinet that assists with retrieval in the brain" (p. 38). *Semantic* memory refers to information regarding words, facts, and dates. *Episodic* memory refers to context and locations. *Procedural* memory encompasses muscle coordination, while *automatic* memory deals with conditioned response. Finally, Tileson believes, *emotional* memory takes precedence over all other types of memory. Saunders and Vawdrey (2002) suggest brain-based learning involves mastering and sequencing ideas so that learning can be transferred to other situations. "Recent brain research has shown that the brain pathways are strengthened with each use: often requiring six exposures (touching, seeing, hearing, doing) before the pathway is strong enough for long-term memory recall" (Saunders & Vawdrey, 2002, p. 45).

5. Assessment – achievement and motivation

"In a brain compatible classroom, assessment both measures achievement and provides motivation" (Goldberg & Stevens, 2001, p. 125). If teachers wish to establish a classroom in which brain-based learning can thrive, Caine, Caine, McClinitic and Klimek (2005) and Caufield, Kidd and Kocher (2000) all suggest allowing students to create some of their assignments and rubrics for marking. Assessment should be designed to fit the students, not vice versa (Caine et al., 2005). Erlauer (2003) suggests that because students are learning through a preferred intelligence, they should in turn demonstrate their knowledge through a preferred intelligence or learning style. Immediate, constructive feedback increases motivation and makes students aware of how to improve their work. As with teaching strategies, effective teachers are more likely to use an appropriate variety of assessment techniques in a brain-based classroom.

6. Biology of the Brain – pathway to understanding

Science has advanced our knowledge of brain biology and has provided information applicable to student learning. Winters (2001) states that recent MRI research has indicated the possible locations where cognitive functions take place relative to learning. Brain research indicates that the brain does not act as a computer, in a linear fashion, as some educators previously thought. Rather, the brain uses multiple strategies to create meaning (Caine, 2000; Caulfield et al., 2000; Slavkin, 2004). In particular, the concept of neural plasticity posits that the brain is continually rewiring itself throughout our lives to access new memories and experiences. Accordingly, brain-based instruction must also be 'rewired' on a continual basis to remain effective.

7. The body, mind, and brain - all for one and one for all

"Amazingly, the part of the brain that processes movement is the same part of the brain that processes learning" (Jensen, 2005, p. 61). Students need to access all their abilities to maximize learning. The use of natural movement in the classroom, such as dancing, clapping, manipulatives, and role play can help promote students' achievement (Caine et al., 2005; Jensen, 2000; Slavkin, 2004). "Teachers benefit by harnessing this natural energy instead of fighting it" (Given, 2002, p. 103). Brain research suggests that one of the most effective tools to maximize student learning is the incorporation of movement into lessons.

8. Time – allotment and student achievement

Duration of time on task is directly proportional to mastery of a concept. However, there are many aspects of time to consider in the brain-based learning classroom. One is the need for students to have time to achieve mastery of a concept or skill before moving on. Another is scheduling regular breaks in the delivery of instruction to allow some time for students to process information and reflect. Caine and Caine (1995) suggest that "…schedules should be tied to the actual time it takes a student to explore a point of view or to master a task, much as in a professional, research, or business setting" (p. 44). Erlauer (2003) and Jensen (in D'Arcangelo, 1998) emphasize the importance of time breaks.

> Studies have shown that adults in the work place need mental and physical breaks to increase productivity, quality, and morale…Attention span studies of children and young adults reveal similar but even more dramatic results. Students need a break in concentration at least every 20 minutes.
> (Erlauer, 2003, p. 76)

9. Collaborative Learning – creating synergy

"If brain-based pedagogy could be summed up in one sentence, it would be, Knowledge should be socially created" (Slavkin, 2004, p. 44). Erlauer (2003) suggests that "Collaborative learning provides the brain with the means to explore new information, typically in a problem-solving situation" (p. 136). Collaborative communities in schools can take many forms. Students can form peer groups and assist each other's learning (Wolfe, 2001).

> When students can share their own knowledge and skills with others, not only do the "receivers" gain because they learn something new, but the student who is acting as the teacher will solidify his or her knowledge teaching it to others. (Erlauer, 2003, p. 145)

Students and teachers can also work collaboratively to make sense of information. This helps create an environment of relaxed alertness to increase student comfort and ability to focus in class (Caine et al., 2005; Pool, 1997).

10. Thematic Instruction – enhances student learning

Thematic instruction encourages students to connect meaningful activities to relevant practice. Through the application of evocative experiences and the relevance of complex situations in which learners are immersed, thematic instruction builds on prior knowledge and enhances comprehension (Caine et al., 2005; Caulfield, et al., 2000; Pool, 1997; Slavkin, 2004; Wagmeister & Shifrin, 2000; Wolfe, 2001). Patterning or chunking information for thematic instruction assists students to mentally 'place' or sort new information in a way that has meaning. This allows for greater internalization and recall of this information can be maximized (Wagmeister & Shifrin, 2000). Teachers can help this process by acknowledging the diversity of learners while focusing on the relationship of students' prior knowledge with the new knowledge to be acquired (Pool, 1997). Students can be intrinsically motivated to actively participate and complete assignments when they are given some ownership over implementation, process, practice, and assessment.

Annotated Bibliography

Caine, G., Caine, R.N., McClintic, C., Klimek, K. (2005). *12 brain/mind learning principles in action*. Thousand Oaks, CA: Corwin Press.
This book presents the authors' findings about brain-based research and its implications for educators in the classroom, through the use of 12 'learning principles'. It has suggestions for teachers at all three levels of instructional style, with the goal of making all teachers effective practitioners of the brain-based theory of teaching.

Erlauer, L. (2003). *The brain-compatible classroom: Using what we know about learning to improve teaching.* Alexandria, VA: ASCD.
This book shows how brain research can be applied to classroom teaching. It offers insights into the many ways that assessment, collaboration, emotions, time, and a safe, enriched learning environment can contribute to student learning. Practical examples are provided from real classrooms in which brain-based learning strategies have been implemented.

Given, B. (2002). *Teaching to the brain's natural learning system*. Alexandria, VA: ASCD.
Givens' book assists teachers in translating some theories of neuroscience into an educational framework for planning. It investigates the brain's structure and function with reference to five major systems; emotional, social, cognitive, physical and reflective and examines how each directly relates to brain-based learning principles.

Goldberg, D. & Stevens, J. (2001). *For the learners' sake: Brain-based instruction for the 21st century*. Tuscon, AZ: Zephyr Press.
This text reviews brain physiology and shows some ways in which research can be translated into classroom practice. It offers a plethora of suggestions and activities teachers can implement directly into their classrooms, all of them focused around brain-brain based learning and instruction.

Jensen, E. (2005). *Teaching with the brain in mind* (2nd ed.). Alexandria, VA: ASCD.
This book describes basic brain anatomy and its relevance to how we learn. Topics include the effects of the environment, emotions, movement, motivation, and critical thinking. The book contains several references to current brain research and suggests how these may be applied to create more effective classrooms by enhancing student comprehension and student achievement.

Slavkin, M. (2004). *Authentic learning: How learning about the brain can shape the development of students*. Lanham, MD: Scarecrow Education.
This book explains brain-based learning through the development of the brain, then discusses what brain-based learning is and how it can be incorporated into the classroom. Slavkin offers suggestions for the kinds of lessons that teachers can use to promote brain-based learning.

Tileston, D. (2005). *10 best teaching practices* (2nd ed.). Thousand Oaks, CA: Corwin Press.
This book provides the classroom teacher with strategies for practical teaching. It focuses on differentiated teaching strategies, teaching for long-term memory retention, collaborative learning strategies, authentic assessment and higher order thinking skills.

Wolfe, P. (2001). *Brain matters: Translating research into classroom practice*. Alexandria, VA: ASCD.
This text is written in three parts, with the first devoted exclusively to learning about how the brain works. The second deals with how the brain takes sensory input and transforms it into stored memory. The third and final section examines practical applications of brain-based research in the classroom.

Supplementary

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Websites of interest

www.brains.org
This site contains practical classroom applications of current brain research. It provides access to suggested readings, hot topics, layered curriculum instruction, newsletters, and workshops. It also contains helpful links to other brain-based websites, and strategies for parents and educators.

www.designshare.com/Research/BrainBasedLearn98.html
This site initially presents 12 design principles based on brain-based learning research. It has access to articles, innovative school designs, e-newsletters and links to national education organizations and publications.

www.jlcbrain.com/truth.html
This is the official Jensen Learning Corporation website. This website contains articles, suggestions on how to stay current with latest brain research, a catalogue of resources and even a brain-based quiz.

www.patwolfe.com
The official site of Mind Matters, Inc. whose mission is to translate brain research to classroom practice. Provides links to articles, training referrals, and workshops.

www.thebrainstore.com/store/
Has a free catalogue of resources available for purchase and teaching tips.

www.unocoe.unomaha.edu/brainbased.htm
Contains information on brain-based learning and its implications for educators.