

BRAIN AND LEARNING RESEARCH: IMPLICATIONS FOR MEETING THE NEEDS OF DIVERSE LEARNERS

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This article provides a brief overview of current brain and learning research and discusses the implications of the research in meeting the needs of diverse learners in the classroom. The author describes dramatic developments in brain research related to brain structure, multiple intelligences, learning styles, emotions and learning, music and cognitive development, and brain-based learning. On the basis of the research, the author proposes the need for multifaceted, complex instruction and resource-rich environments for students. She asserts that each and every child has a unique brain and a great capacity to learn when exposed to relevant learning strategies.

Teachers and administrators face enormous challenges to effectively prepare all students for a technological and global society. There is an ever-increasing diverse range of student abilities, as well as a multiplicity of intelligences, present in our schools. Each and every child has great capacity to learn when exposed to effective and relevant learning strategies. Current brain and learning research can lead to the identification of educationally meaningful differences among individuals and equal opportunities for academic success.

Overview of Brain and Learning Research

Brain Structure

Dramatic developments in brain research and imaging technology are rapidly advancing our conceptualization of the human brain. Sylwester (1993, 1994) discloses how modern studies of brain structure show incredible complexity of approximately 100 billion neurons, each

connected to thousands of other neurons and forming more connections than there are atoms in the entire universe. Describing the brain as modular, Sylwester explains how a few standard nonthinking components combine information to form a complex cognitive environment. The brain is powerfully shaped by genetics, development, and experience while actively shaping the nature of our experiences and culture in which we live.

Current brain studies underscore the important role adults play in facilitating an early stimulating environment for children. Calling for classrooms that are closely related to real-world environments, Sylwester believes curricula must include many sensory, cultural, and problem layers that stimulate the brain's neural networks.

Multiple Intelligences

Teachers must be allowed to celebrate the richness of their students. Accordingly, all students must be given opportunities

to express their varied talents and to apply complex problem solving that needs to follow any learning. Gardner (1993) presents a pluralistic view of the mind by recognizing different facets of cognition and acknowledging that people have many different mental strengths and contrasting cognitive styles. He suggests that most students who achieve academic success have done so because their strengths in critical reading and calculation promote higher scores on paper and pencil instruments. Gardner defines intelligence as the ability to solve problems or fashion products that are valued in one or more cultural or community settings. Another criteria for Gardner's definition of intelligence is that an ability must have a particular representation in the brain.

Gardner's initial research led to the identification of seven intelligences. Linguistic intelligence is the capacity to use language for expression and understanding other people. Logical-mathematical intelligence is logical and mathematical ability, as well as scientific ability. Spatial intelligence refers to the capability to form a mental model of a spacial world and to operate using that model. Bodily kinesthetic intelligence is the ability to solve problems or create products using the whole body or parts of the body. Musical intelligence is the capacity to think in music, to hear musical patterns, and create musical products. Interpersonal intelligence is the ability to understand other people and work cooperatively with them. Intrapersonal intelligence is the capacity to understand oneself and use that knowledge to operate effectively in life.

In an interview with Checkley (1997),

Gardner discusses the identification of an eighth intelligence. The naturalist intelligence designates the ability to discriminate among living things, as well as a sensitivity to other features of the natural world. Each person is unique in his particular combination of intelligences. Making the case for the plurality of intellect, Gardner asserts the purpose of an education should be tied to an understanding of how minds differ from each other and calls for individual-centered schools geared to optimal development of each student's cognitive profile. Students in today's schools should be given the chance to exercise their intellectual area of expertise.

Further studies on the nature of intelligence support the promising concept that anyone can learn to behave more intelligently. Perkins (1995) identifies three distinct kinds of intelligence. The fixed neurological intelligence is linked to IQ tests such as the Stanford-Binet Intelligence Test. The intelligence of specialized knowledge and experiences is acquired over time. The ability to become aware of one's mental habits and transcend limited patterns of thinking is reflective intelligence. Perkins suggests that recent studies prove that intelligence is not genetically fixed and can be taught. He debates the issue by centering around the concept of mindware, information and processes that enable people to learn to solve problems, make decisions, understand complex concepts, and better perform intellectual tasks. Strategies for problem solving, decision making, creative thinking, and metacognition are significant in enhancing cognitive development. Dispositions in thinking are both teachable and learnable.

Educators can cultivate reflective intelligence by infusing thinking skills and mental processes with the curriculum. The science of learnable intelligence is young, and Perkins hopes that powerful ways of teaching intelligence will continue to be discovered.

Learning Styles

Each student processes and absorbs new information in a different way. Identifying learning styles and teaching to those learning styles can increase academic achievement and improve attitudes toward learning. Dunn (1995) describes how children learn according to their visual, auditory, or kinesthetic learning style that develops through interactions of biology and experience. Each child processes new information in ways that are related to environmental, emotional, sociological, physiological, and psychological elements. Dunn maintains that uniform teaching practices will invariably deny many students success in the classroom.

Analyses of the learning styles of under-achieving students by Griggs and Dunn (1995) reveal that these students' learning styles differ significantly from the learning styles of high achievers. Moreover, their research affirms that teaching and counseling these students congruently with their learning-style preferences results in increased test scores and positive outlook on learning. Griggs and Dunn conclude from their studies on learning styles and cultures that there is great diversity within ethnic groups and fear that generalizations about a group of people often lead to incorrect inferences about individual members of that group. As a

result, Griggs and Dunn recommend that teachers should concentrate not on cultural-group characteristics but on learning-style strengths of each individual student. Similarly, Guild (1994) maintains that although cultures have distinctive learning style patterns, the great variation among individuals within groups means that teachers should use diverse teaching strategies with all students. According to Guild, Griggs, and Dunn, a deep understanding of culture and learning styles leads to sound instructional decisions based on each student's culture and ways of learning.

Emotions and Learning

Children's emotions must be recognized and their importance for learning accepted. Studies by Sylwester (1994) reveal that emotions drive attention and in turn, drive learning and memory. Since more neural fibers project from the brain's emotional center into the logical/rational center than the reverse, emotion tends to determine behavior more powerfully than rational processes. Thinking in terms of an integrated body/brain system, Sylwester describes how the emotional system is located in the brain, endocrine, and immune systems while also affecting all the other organs of the body. Therefore, chronic emotional stress has adverse effects on the body. Stressful school environments inhibit learning while positive classroom atmospheres encourage chemical responses in students that help them learn. Children naturally seek out and thrive in places where caring is present. Integrating emotional expression in a caring classroom atmosphere improves memory and stimu-

lates the brain to learn.

Music and Cognitive Development

The latest neurological research on brain development and its relationship to music education reveals that training in music has a positive effect on cognitive development. According to Black (1997), musical experiences are displayed in the brain as multimodal, involving auditory, visual, cognitive, affective, and motor systems. Both the right and left hemispheres of the brain are involved in processing music. The musical nourishment and enrichment of young children stimulates the formation of connections (synapses) and the growth of branching extensions (dendrites) in the brain. Training in music at an early age exercises higher brain functions, including complex reasoning tasks. Musical skills help children develop in other areas, such as math, language, and spatial reasoning. Black criticizes schools that have eliminated formal music in a child's education. He supports the introduction of music lessons in preschool that continue throughout a child's academic program as an integral part of a school's curriculum.

Brain-Based Learning

Educators need a strong theoretical base for what they do to guarantee that a new approach to teaching is not one more invention or trend. The strengths of a brain-based approach to learning is that it is based on work from cognitive psychology and both educational and neurophysiological research. Caine, Caine, and Crowell (1994) stress the importance of educators developing an accurate model of how students

learn by implementing twelve principles of brain-based learning into their curriculum. They describe the brain as a parallel processor that performs many functions simultaneously. Therefore, all meaningful learning is complex and nonlinear. Learning engages the entire physiology. Stress management, nutrition, exercise, and maturation are some of the physiological functions that affect the capacity to learn.

Caine, Caine, and Crowell assert that the search for meaning is basic to the human brain and takes place by patterning. Learning is enhanced by combining a rich environment with complex and meaningful challenges. Isolated pieces of information unrelated to what makes sense to a student is resisted by the brain. Emotions are critical and at the heart of patterning. What is learned is influenced and organized by emotions, self-esteem, and the need for social interaction. The brain processes parts and wholes simultaneously. That is, the left and right hemispheres are interactive and organize information best when it is learned in context. Learning involves conscious and unconscious processes, thus students need to reflect on how and what they learn for the development of personal meaning.

According to Caine, Caine, and Crowell, memory is organized through a spacial memory system and a rote learning system. The more separated information and skills are from a student's prior knowledge and experience, the more dependence there needs to be on repetition and memorization. Understanding and memory are enhanced when facts and skills are embedded in natural, spatial memory. For example, native language is learned

through multiple interactive experiences involving vocabulary and grammar and is shaped by both internal processes and social interaction. Furthermore, memory and learning are affected by the learning environment. The brain downshifts under perceived threats and learns optimally when appropriately challenged.

Each brain is unique. The systems of the human body are integrated differently in every brain, and as learning changes the structure of the brain, the more individual we become. Caine, Caine, and Crowell emphasize that educators need to facilitate optimal brain functioning.

Educational Implications of Brain and Learning Research

There is much evidence that individuals do not all learn in the same way. If we require students to receive information in a way which does not correspond with their personal dominant learning modes, to perform under conditions which interfere with their learning, or to demonstrate their learning in a manner which does not allow them to use their strengths, artificial stress is created, motivation is reduced, and performance results are depressed. In contrast, we must take the responsibility for teaching diverse learners and break from the tradition that uniform practices are effective for all.

Educators must be willing to develop individual learning profiles for each student and prepare for complex instruction. Complex instruction is multifaceted and involves providing a variety of instructional materials, resources, groupings, and assessment instruments. Moreover, structured classroom time devoted to social and

emotional skill building, group problem solving, and team building strengthens academic learning. Brain and learning research indicates that the brain responds more to learning environments that are enriched and that involve as many of its processing centers as possible. Educators have to allow for children to have rich experiences and then give them time and opportunities to make sense of their experiences by reflecting and finding connections in how things relate. Lessons stimulating senses, emotions, and memory aid cognition and future retrieval in real world situations.

An example of a type of enriched learning experience is placing students in small groups and assigning problems that are open-ended, challenging, and related to the real world. Within the groups, students are given tasks that are organized around central themes that can be learned in different ways and require a variety of abilities. A product is developed and presented to the class. Individual assignments center around each student's reflections on what was learned and how well the problem was solved and presented to the class. Another type of enriched learning experience is learning or interest centers that allow for student exploration and experimentation. The resource-rich environments of preschools and kindergartens should be implemented in the higher grades. When resources are rich, the number of avenues for learning expands. In a multimodal classroom direct teaching and lectures are not excluded, but are a small piece of the total learning experience. Assessments include more than paper-and-pencil tests, and students participate in evaluating their learning process and their progress.

Students should be given choices and encouraged to discuss their emotions and listen to others' expressions of feelings. They should be challenged to ask their own questions and research plausible answers. When possible, activities should engage students' bodies and emphasize social interactions. Games, simulations, role playing, field trips, dance, art, and music must be incorporated into the curriculum and supported financially by the school community. In addition, mentorships with adults, other students, and teachers should be encouraged in a safe and nurturing context.

Teachers must help students understand the meaning of new information with such avenues as stories, complex themes, and metaphors. Lessons need to be generally exciting and meaningful and offer students a variety of choices. Students must be allowed to research and understand opposing points of view in literature, history, and current issues. They gain experience in communicating complex ideas and in supporting, testing, and expanding their own thoughts. The environment of the classroom must be marked by mutual respect and acceptance. Teachers need to engage students through their own enthusiasm and modeling, signaling to the students the value of what is being learned. The promotion of knowledge, thinking skills and processes, responsibility, and caring encourages a reflective, ready-to-learn approach to all areas of life.

Classroom teachers should receive comprehensive staff development in research and methods that promote optimum learning for all students. Equally important, teachers must be empowered

to develop the knowledge base that extends their understanding of teaching and learning. Allotting time for teachers to plan complex lessons, share ideas, and reflect on curriculum and student learning is crucial in effectively creating a community of learners.

Success for the diverse populations that schools serve requires reexamination of our beliefs about teaching, learning, the nature of human beings, and the kinds of environments that maximize growth for students and teachers alike. Teachers can meet diverse learning needs by intentionally applying multiple strategies and creating positive environments in which students discover patterns and meanings. Educators are responsible for using current brain and learning research to teach multi-sensory processes, create events, and introduce materials and ideas into the classroom that will encourage the development of neural network connections in all students. Equity of opportunity does not reside in a common program for all. It resides in educators that generate a learning community that nurtures and supports diversity.

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(Continued on page 681)

be seen as an intervening variable between school-related relationships and academic success. Cassidy and Lynn (1991) and Grolnick and Slowiaczek (1994) both found that motivation mediated the relationship between a number of personal or family characteristics (e.g., parental involvement) and academic achievement. It may well be that motivation plays a similar intervening role when school climate and academic achievement are considered.

The results of this study suggest the need for a longitudinal study to determine possible cause and effect between the variables and academic achievement. It would be appropriate to also examine the impact that motivation has on these relationships. Such considerations as why demographic variables (e.g., gender) have an influence may receive additional attention in such a study.

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(Continued from 687)

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The chapter on learning and transfer was useful for me, because my current studies focus on Kolb's Experiential Learning model. While the text did not include a lot of substance when it came to how to motivate students, more of an idea that motivation is key, it did emphasize that learners need to understand how a topic can relate to their life beyond the classroom. The research in this book supports that both process and product are key to a learner's development, as well as meaningful assessment--not just handing out grades and moving on. This book is a valuable addition to the library of any educator who seeks to improve their practice through research. I needed this book for a university course. It arrived in good shape and seems to be a good book. Read more.