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FOUR

FIVE

SIX

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INTRODUCTION

For thousands of years, humans have been delving into the mysteries of the human brain and trying to determine how it accomplishes its amazing feats. How fast does it grow? What impact does the environment have on its growth? What is intelligence? How does the brain learn language? How does it learn to read? Just how the brain learns has been of particular interest to teachers for centuries. Now, in the 21st century, there is new hope that our understanding of the remarkable process of teaching and learning will improve dramatically. A major source of that understanding comes from the sophisticated medical instruments that allow scientists to peer inside the living – and learning – brain.

As we examine the clues that research is yielding about learning, we recognise their importance to educational practice. Every day, teachers enter their classrooms with lesson plans, experience and the hope that students will understand, remember and use what teachers are about to present. The extent that this hope is realised depends largely on the knowledge base that these teachers use in designing those plans and, more important, on the instructional techniques they select during the lessons. Teachers try to change the human brain every day. The more they know about how it learns, the more successful they can be.

Classroom teachers are often undecided on what areas of inquiry to pursue for professional growth. Principals, especially in primary schools, play an important role in helping teachers select an area from myriad possibilities. When principals guide teachers towards understanding more about how the brain learns, they demonstrate the *instructional* leadership that schools will need to ensure that they are preparing students to meet the challenges of a 21st century world.

Educators in recent years have become much more aware of neuroscience's findings in how the brain works, and they are aware that some of the discoveries have implications for what happens in schools and classrooms. There is a growing interest among educators in the biology of learning and how much an individual's environment can affect the growth and development of the brain. Teacher training institutions are beginning to incorporate brain research into their courses, although progress has been slow. Professional development programs are devoting more time to this area, more books about the brain are available, brain-compatible teaching units are sprouting up and the journals of most major educational organisations have devoted special issues to the topic. Several universities in North America (for example, the Mind/Brain Institute at Johns Hopkins University and MIT's Department of Brain and Cognitive Sciences) and abroad have established dedicated research centres to examine how discoveries in neuroscience can affect educational practice. Harvard University now offers a master's degree in its

mind, brain and education program. As a result, educational theory and practice will become much more research based, similar to the medical model.

There is, of course, no panacea that will make teaching and learning a perfect process – and that includes brain research. It is a long leap from making a research finding in a laboratory to the changing of schools and practice because of that finding. These are exciting times for educators, but we must ensure that we do not let the excitement cloud our common sense.

With those thoughts in mind, this book is designed to bring busy educational leaders up to date on the latest brain research that appears to have implications for both teaching and learning, as well as for leading schools as learning organisations. Indeed, the ideas in this book provide the research support for a variety of initiatives, such as cooperative learning groups, differentiated instruction, integrated thematic units and the interdisciplinary approach to curriculum. The chapters delve into the major characteristics of brain-compatible curriculum, instruction, assessment and leadership. Those educators who are familiar with constructivism will recognise many similarities in the ideas presented here.

Important Note

The goal of this series of books is to help principals focus on the major components of the topics covered. Thus, the title of this book states that it addresses the *basics* for creating a brain-compatible classroom. The hope is that after reading this book, principals will want to pursue the topics in greater depth in order to provide their teachers with meaningful professional development activities that enhance their knowledge and skills about brain-compatible learning. In the references (page 97), readers will find numerous sources that will help them delve deeper into the topics presented in this book. The glossary (page 93) will explain the technical terms used in the text.

Chapter Contents

Chapter 1 begins with a quick tour of brain structures and reviews some of the recent discoveries about how the brain grows, develops, and processes and organises information. It looks into memory and attention systems and explores the way emotions affect learning. It concludes with an examination of the fascinating discovery of mirror neurons and their impact on the development of the social brain.

Deciding what students should learn is a major responsibility of schools. However, how well does the chosen curriculum meet the expectations that students have of their schooling experience? The young brain of today's students has been developing in a rapidly changing environment. Does today's curriculum account for the changes, and is the curriculum evolving to meet the needs of these technologically primed students? These are the important questions addressed in chapter 2.

Students learn best in a climate that is free from threats and that promotes active participation in the learning process. Chapter 3 discusses ways to establish that positive classroom and

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school climate. It also offers suggestions on how much to teach in a lesson, how to get and maintain student attention, when to present important information and how to teach for retention of learning. The procedures for conducting action research are also described.

Much of school assessment today is still summative in nature and driven by high-stakes testing and demands for student and teacher accountability. However, research reveals that students are more likely to remain involved in their learning and persist when the going gets tough if they get consistent, specific feedback on their progress through formative assessments. Chapter 4 suggests ways that teachers can use formative assessments effectively.

Chapter 5 debunks some common misconceptions about students with special needs and suggests ways for identifying students with persistent learning difficulties. It also suggests how teachers can make simple modifications to curriculum, instruction and assessment to accommodate students with special needs. The needs of gifted and talented students as well as English learners (ELs) are explored, and practical suggestions for helping these students succeed are presented.

Some findings from brain research have implications beyond the classroom for school leadership in general. Chapter 6 examines how the brain influences the decision-making process, and how school leaders can use this information to build more productive and successful problem-solving teams. The components necessary for brain-compatible professional development are also reviewed, as well as the pitfalls of being too successful as a leader.

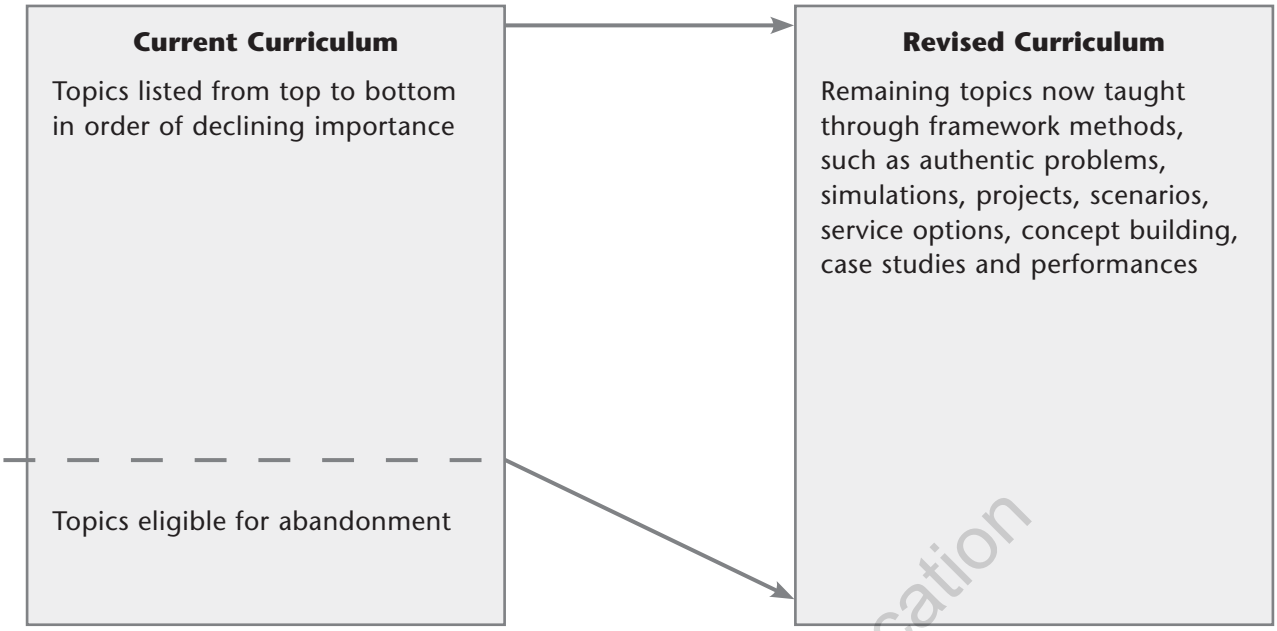

Figure 2.3: A simple model for selective abandonment.

Chunking Related Topics

Working memory can handle only a few items at once. This functional capacity changes with age. Preschool infants can deal with about two items of information at once, while preadolescents can handle three or four items. Through adolescence, further cognitive development occurs and the capacity increases slightly to four or five items. This limited capacity explains why we have to memorise a song or a poem in stages. We start with the first group of lines by repeating them frequently (a process called *rehearsal*). Then we memorise the next lines and repeat them with the first group and so on. In effect, we increase the number of items within the functional capacity of working memory through a process called *chunking*.

Chunking occurs when working memory perceives a set of data as a single item, much as we perceive *strategies* as one word (and, therefore, one item) even though it is composed of ten separate letters. Chunking allows us to deal with a few large blocks of information rather than many small fragments. Problem solving involves the ability to access large amounts of relevant knowledge from long-term memory for use in working memory. The key to that skill is chunking. The more a person is able to chunk in a particular area, the more expert the person becomes. These experts have the ability to use their experiences to group or chunk all kinds of information into discernable patterns (Perlman, Pothos, Edwards & Tzelgov, 2010).

Chunking is a very effective way of enlarging the capacity of working memory. It can be used to memorise a long string of numbers or words. Most of us learned the alphabet in chunks – for some it may have been *abcdefg*, *hijklmnop*, *qrs*, *tuv*, *wxyz*. Chunking reduced the twenty-six letters to a smaller number of items that working memory could handle. Even people can

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be chunked, such as couples (Romeo and Juliet, Bonnie and Clyde, Burke and Wills), in which recalling the name of one immediately triggers the name of the other. Although working memory has a functional capacity limit as to the number of chunks it can process at one time, researchers have not been able to determine the maximum number of items that can be combined into a chunk (Cowan, Morey, Chen, Gilchrist & Saults, 2008). Teaching students how to chunk information can greatly increase learning and remembering. Chunking is a *learned* skill.

Thus, one of the most valuable contributions that educational leaders can make towards a brain-compatible curriculum is to insist that it be chunked. Because the curriculum committee established to carry out selective abandonment is very familiar with the topics, it can also look at ways of chunking the curriculum in a course or year level so that students are able to deal with more information at one time and make the necessary connections that will result in retention of learning.

There are different types of chunking. During curriculum revision, topics that fit into pattern or categorical chunking should be taught together regardless of where they appear in the basic text.

- **Pattern chunking:** This is most easily accomplished whenever we can find patterns in the material to be retained. The committee reviews the topics that are to be covered in the curriculum before determining the instructional sequence. Committee members look for patterns between and among topics. For example, do some topics occur within a similar time frame or are they related geographically? Almost any pattern that the learner perceives can be the basis for chunking. Step-by-step procedures – for tying shoelaces or copying a computer file, for example – are learned through pattern chunking. We group the items in a sequence and rehearse it mentally until it becomes one or a few chunks. Practising the procedure further enhances the formation of chunks and subsequent performance requires little conscious attention.
- **Categorical chunking:** In this more sophisticated chunking process, the curriculum sequence is designed so that the learner establishes types of categories to help classify large amounts of information. The learner reviews the information, looking for criteria by which to group complex material into simpler categories or arrays. The different types of categories can include the following.
    - **Advantages and disadvantages** – The information is categorised according to the pros and cons of the concept. Examples include debating energy use policy, abortion and capital punishment.
    - **Similarities and differences** – The learner compares two or more concepts using attributes that make them similar and different. Examples are comparing Sydney to Melbourne, mitosis to meiosis and World War II to the Vietnam War.

- Emotions enhance retention, so the positive feelings that result from laughter increase the probability that students will remember what they learned.
- Schools and all their occupants are under more stress than ever. Taking time to laugh relieves that stress and gives the staff and students a better mental attitude for accomplishing their tasks.
- Good-natured humour (not teasing or sarcasm) can remind students of the rules without raising tension in the classroom. Teachers who use appropriate humour are more likeable and students have a more positive feeling towards them. Discipline problems, therefore, are less likely to occur.

Humour can be used throughout the lesson and should not be limited to an opening joke or story. Teachers can look for ways to use humour within the context of the learning objective as well. It is important to avoid sarcasm. Sarcasm is inevitably destructive to someone. Even some well-intentioned teachers say, "Oh, I know my students very well, so they can take sarcasm". However, more students are coming to school looking for emotional support. Sarcasm is one of the factors that can undermine that support and turn students against their peers and the school. Educational leaders also need to remember the value of humour in their relationships with staff, students and parents. As leaders, they set the example; in meetings and other settings, they can show that humour and laughter are acceptable in schools and classrooms. Let's take our work seriously but ourselves lightly!

Importance of School Climate

Research studies indicate that school climate has a significant impact on student behaviour and achievement as well as teacher performance (Loukas, 2007; Marshall, 2004). The factors that influence school climate include:

- academic performance
- quality of instruction
- teachers' expectations of student achievement
- school size
- level of safety and comfort
- number and quality of interactions between and among students, teachers and staff
- environmental components, such as instructional materials, availability of resources, and physical condition and appearance of building and classrooms
- relationships between teachers and students
- students' and teachers' perceptions of their school environment and the degree to which they contribute to decision making at the school

Although all of these factors can affect teaching and learning outcomes, researchers cite school connectedness as having a particularly strong influence (Blum, 2005). *School connectedness*

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Misconceptions About EL Students

Several misconceptions about how EL students acquire English persist, largely because many teachers have not had sufficient training in understanding how the brain acquires a second language and understanding the unique needs of ELs. Despite their good intentions, teachers with this lack of training may make classroom decisions that may not be the most effective in helping EL students achieve success. Table 5.3 lists some misconceptions about English learners (Harper & de Jong, 2004).

Table 5.3: Misconceptions and Current Understandings About English Learners

Misconceptions	Current Understandings
ELs will learn English when exposed to the language and when interacting with native English speakers.	Learning English requires that ELs pay conscious attention to the grammatical, syntactic and phonological aspects of the language as well as direct instruction in the relationships between the forms and function of the language.
All ELs learn English in the same way and at the same rate.	Some ELs acquire social language quicker than academic language and literacy, while for others, academic language skills progress more rapidly. Also, how similar the ELs' native language is to English will affect their rate of learning.
Using visuals and other nonverbal tools in instruction helps ELs avoid English-language demands in school.	These tools may help ELs comprehend very complex content, but should be used in addition to academic language instruction, not in place of it.
The more time ELs spend receiving English instruction, the quicker they will learn English.	ELs who are taught using at least some of their native language perform better in English reading than similar students taught only in English.
Errors in English may cause problems and should be avoided.	It is natural to make errors and the types of errors will differ depending on the EL's native language.

Instructional Components

Successfully teaching English learners, including those with learning difficulties, depends on careful attention to the following components (Sousa, 2011).

- **Native-language development:** Developing the ELs' native language helps to develop their learning of English. Total English immersion programs are not as effective as those that transition from the EL's native language to English over time. Contrary to some beliefs, ELs can develop both English and their native language and develop literacy skills as they are learning English. The more teachers know about how to connect common characteristics from the ELs' first language to English, the more successful they can be in teaching them English and academic content material.
- **English-language acquisition:** Teachers should understand the cerebral processes at work as the EL brain learns English, and how native-language transfer can both help

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GLOSSARY

amygdala. The structure in the brain's limbic system that processes and encodes emotional information.

attention deficit/hyperactivity disorder (ADHD). A syndrome that interferes with an individual's capacity to regulate activity level, inhibit behaviour and attend to tasks in developmentally appropriate ways.

axon. The neuron's long and unbranched fibre that carries impulses from one neuron to another.

brain-imaging technology. The various devices that allow researchers to look at the structure (CAT scans and MRIs) and function (PET scans and fMRIs) of the living brain.

brain stem. The structure that connects the brain to the spinal column; it monitors and controls vital functions, such as body temperature, blood pressure, heartbeat and digestion.

cerebellum. A major part of the brain mainly responsible for coordinating muscle movement.

cerebrum. The largest part of the brain, comprising the four lobes; it controls sensory interpretation and integration, thinking and memory.

chunking. The ability of the brain's memory systems to perceive a coherent group of items as a single item or chunk.

closure. The teaching strategy that allows learners quiet time in class to mentally process what they have learned during a lesson.

corpus callosum. The bridge of nerve fibres that allows communication between the brain's left and right hemispheres.

cortisol. A natural steroid produced because of stress.

dendrite. The branched extension from the cell body of a neuron that receives impulses from nearby neurons.

diagnostic assessment. An instrument designed to determine a student's point of entry into a unit of study relative to the unit's stated outcomes, or a student's interests or learning profile.