DESIGNING BRAIN-COMPATIBLE LEARNING

Second Edition

Terence Parry
Gayle Gregory

HAWKER BROWNLOW
EDUCATION

CONTENTS

INTRODUCTION

ABOUT THIS BOOK

This book is about designing learning experiences that combine the best of what we know about how the brain learns with the best of what we know about teaching. Our primary goal is to make sense of the wealth of information that exists and condense it into a format that is both teacher friendly and practical.

There is a growing sense of frustration among teachers regarding the sheer number of educational innovations that bombard them on a regular basis. We believe this frustration will be decreased when teachers can make sense of the mass of information by focusing on a limited yet powerful set of research-based instructional strategies.

In the first two chapters, we delve into the research of how the brain learns based on the works of Robert Sylwester, Gerald Edelman, Daniel Goleman, Marian Diamond, Renate Nummela Caine, Geoffrey Caine, David Sousa, Marilee Sprenger, and Pat Wolfe and then establish a link between this information and current educational theories as proposed and described by Howard Gardner, David Perkins, Jacqueline Brooks, Martin Brooks, Robin Fogarty, Jay McTighe and Art Costa. Using cognitive research and pedagogical theories, we have developed a set of skills and strategies that fall under the general rubric of brain-compatible instruction.

In chapter 3, we share a framework for lesson design. This framework offers teachers multiple strategies to 'paint' a brain-compatible lesson. The artist's palette is used as a metaphor for selecting colours (instructional strategies) and mixing them in a unique lesson.

In chapter 4, we examine three theories of intelligence: multiple intelligences (Gardner 1983), emotional intelligence (Goleman 1995) and intelligent behaviour (Costa 1995). We include suggestions for applying the theories to classroom practice.

In chapters 5 and 6, we discuss cooperative group learning and collaborative skills, which are presented as master strategies that facilitate the implementation of all the other teaching suggestions in this book.

Chapters 7 and 8 cover thinking skills and graphic organisers. For the purpose of clarity, these are presented as separate topics; however, in practice they are often used in combination with each other.

The final chapter provides suggestions for assessment in the brain-compatible classroom. It includes tips on how to use alternate forms of assessment (such as projects, performances and portfolios), establishing criteria and using assessments to promote student growth.

In effect, we have created a tool kit for teachers that contains a comprehensive set of best teaching practices. Many of these strategies are familiar to teachers – some may have been forgotten, others may not have been used in a while. This book calls the strategies back into mind, organises them, provides a rationale for their use and gives some suggestions for integrating them into the classroom.

The strategies in the tool kit may be transferred to the classroom by using a framework for designing brain-compatible learning through lesson planning. The framework is designed so that all the strategies are on display at all times during the lesson design process. This is to remind us of the range of options available, therefore increasing the chances that we will use an expanded repertoire of instructional skills in our day-to-day teaching.

The public, in general, and parents in particular, are sometimes sceptical of educational innovation. Often this is because no one has explained the innovations to them or not enough information has been provided to make clear the purpose of the innovations. As teachers, we are often so busy implementing new ideas that we do not have time to achieve a thorough understanding of the research that supports them. This can lead to situations where we are at a loss to define what we are doing and why we are doing it. For this reason, we have organised the information in each chapter under three general headings: What is it?, Why do we need it?, and How do we do it?

The What Is It? section of each chapter introduces the key concepts related to the chapter topic, provides a working definition of the skills or strategies and presents research findings related to these ideas.

The Why do we need it? section provides the rationale for the skills or strategies and states why they are important and how they are connected to the concept of brain compatibility. The importance of the rationale cannot be overstated, because it is as important to understand why we are adopting a particular strategy as it is to know how to do it.

The How do we do it? section provides a step-by-step approach to using particular skills as well as examples of how they may be applied in the classroom.

Reflections are included at the end of many chapters to enhance individual or group learning.

Example worksheets are provided at the end of several chapters.

Note the glossary and bibliography for clarification of strategies and brain-related terms and additional readings.

CHAPTER 1

COGNITIVE RESEARCH

WHAT IS IT?

Much of what is known about how the brain learns has been discovered in the past twenty-five years. For the first time, scientists are able to examine the internal organisation and working of the brain as opposed to merely observing the external behaviour that results from brain activity. The advent of brain imaging technology has provided a window into the skull that allows scientists and researchers to observe how and where information is manipulated in the process we call learning. The CT (computerised tomography) scan can create a graphical three-dimensional image of the brain. The PET (positron-emission tomography) scan can monitor the pattern of blood flow to various parts of the brain and allows observers to see which parts 'light up' as the brain processes information.

Cognitive researchers are just beginning to understand how the brain interacts with the external environment to acquire information, to manipulate and process it, to store it as memory and to retrieve it on demand. Educators, neuroscientists, cognitive psychologists and researchers such as Renate Nummela Caine, Geoffrey Caine, Marian Diamond, Gerald Edelman, Howard Gardner, Jane Healy, Eric Jensen, Robert Sylwester and Pat Wolfe have provided a variety of theories of how the brain learns.

The brain is like . . .

The organisation and functions of the brain are predicated on a number of very complex ideas. One way to understand these complex ideas is through the use of metaphors and analogies. These comparisons afford us a place to begin our understanding of the brain, and although they provide somewhat distorted representations, they give us approximations that simplify complex ideas.

One discovery from research is that the brain makes sense of the world by constructing meaning from the information around it (Caine and Caine 1994).

One way it does this is by connecting information about something it already knows to the new concept that it is trying to understand. For example, we can use the computer (something we know about) as an analogue for the brain (something we are trying to learn about). We then can take our knowledge about computers and apply it to the brain in an attempt to understand it.

The computer analogy works well for most people when trying to learn about the networks of brain cells and the ways in which they are connected, especially if they already understand networks, connections and wires. However, the analogy breaks down when we use it to explain how the brain is organised or how it transmits information.

To explain these concepts we need another analogy – the jungle. Neurobiologist Gerald Edelman (1992) proposed that the organisation and functions of the brain are more analogous to a jungle or a rainforest than they are to a computer. According to his theory, the brain is a rather messy and disorganised place. Like a jungle, it has no external controller and few predetermined goals other than to survive. In fact, survival is its primary function. Survival is also the main reason that the brain engages in learning. In a jungle, no outside agency or group is in control; each species of plant and animal goes about its own business, never thinking that it is part of a master plan. However each organism is, in fact, part of a system within other interdependent systems, which together form one giant ecosystem. All of the animals and plants have the capacity to thrive and reproduce, but some do and some don't; this is natural selection at work. The jungle does not tell the individual species *how* to survive; it merely supports the survivors.

The brain is organised in a similar fashion. No one part of the brain is in charge and it is made up of myriad interconnecting systems. Each system goes about its own business, but also contributes information that allows the brain to survive.

All systems in the brain have the capacity to survive. As in the jungle, some thrive, some don't. The brain supports the winners, which are the neural systems that are stimulated by their environments and frequently used. This process operates similarly to the way in which we retain many of our physical capabilities – we either use them or lose them. Just as muscles become stronger through use and weaker through disuse, neural networks that are used strengthen and those that are not used weaken. When a neural network weakens, the cells within it may become rededicated to other uses. This is called neural pruning.

An example of neural pruning is evident in the process of language acquisition. We are born with the capability to make all the sounds and learn the vocabularies and grammatical structures of every language spoken by humans. In many cases, however, we learn only one. The networks that are not found in one's native tongue eventually weaken through a lack of use and, in some cases, are lost forever.

The 'double l' sound in the Welsh language, found in words such as Llangollen and Llewelyn, is a case in point. If one does not learn the sound early, the chance of being able to acquire it later is not very promising. Similarly, native speakers of Cantonese who learn English as adults often have difficulty with the 'th' sound in English words, whereas Chinese children raised in English-speaking environments have no such difficulty.

The brain has two primary kinds of cells: nerve cells and glial cells. The nerve cells, called neurons, form a complex network that transmits information to all parts of the brain/body system. To visualise a neuron, imagine an old-fashioned floor mop with a wooden handle and a head made from twisted cotton fibres. Now imagine that the handle has begun to split apart. The dense part of the broom represents the cell body and the individual strands of the mop are the dendrites. The stick is the axon, which is an extension of the cell body, and the split ends of the stick represent the axon terminals (see Fig 1.1).

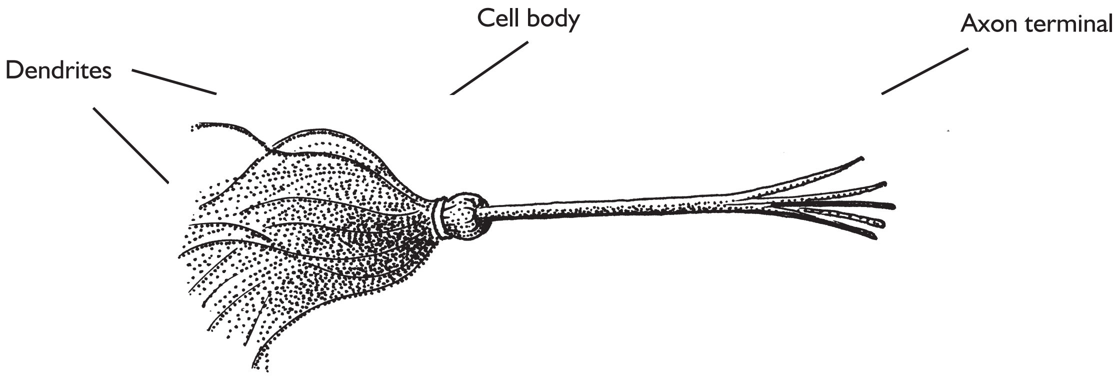

Figure 1.1