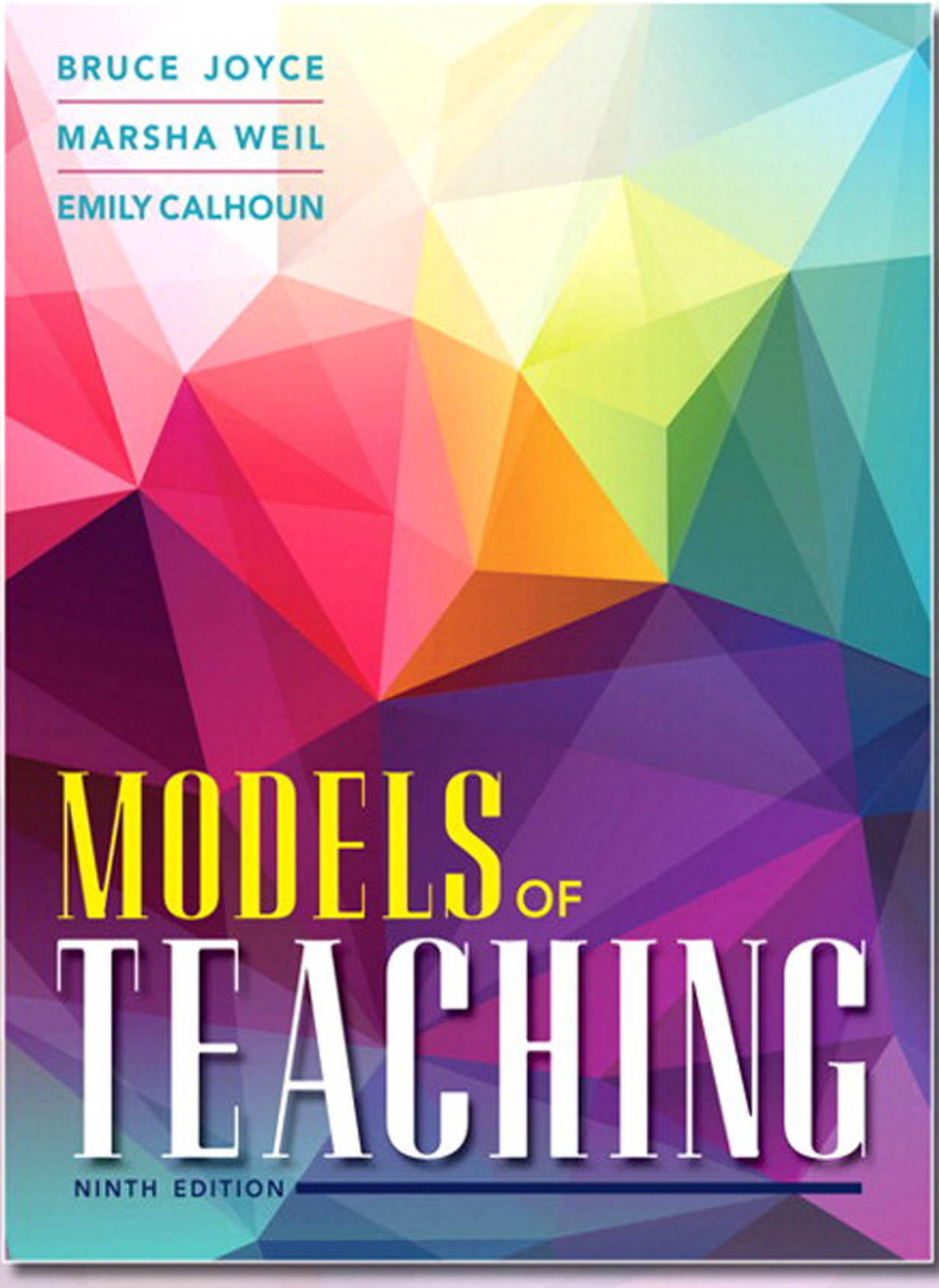

BRUCE JOYCE
MARSHA WEIL
EMILY CALHOUN
MODELS OF TEACHING
NINTH EDITION

Models of Teaching

This page intentionally left blank

Models of Teaching

NINTH EDITION

Bruce Joyce
Booksend Laboratories

Marsha Weil
ETR Associates

Emily Calhoun
The Phoenix Alliance

PEARSON

Boston Columbus Indianapolis New York San Francisco Upper Saddle River
Amsterdam Cape Town Dubai London Madrid Milan Munich Paris Montréal Toronto
Delhi Mexico City São Paulo Sydney Hong Kong Seoul Singapore Taipei Tokyo

Vice President, Editor in Chief: Jeffery W. Johnston
Senior Acquisitions Editor: Meredith D. Fossel
Editorial Assistant: Maria Feliberty
Marketing Manager: Darcy Betts
Program Manager: Janet Domingo
Project Coordination and Text Design: Electronic Publishing Services Inc., NYC
Operations Specialist: Linda Sager
Electronic Composition: Jouve
Cover Design: Diane Lorenzo

Credits and acknowledgments borrowed from other sources and reproduced, with permission, in this textbook appear on the appropriate page within text.

Library of Congress Cataloging-in-Publication Data

Joyce, Bruce R.
Models of teaching / Bruce R. Joyce, Marsha Weil, and Emily Calhoun.
pages cm
Includes bibliographical references and index.
ISBN 978-0-13-374930-4 1. Education—Experimental methods.
2. Educational innovations. 3. Teaching. I. Title.

LB1027.3.J69 2015
371.102—dc23

2013038897

10 9 8 7 6 5 4 3 2 1

PEARSON

ISBN 10: 0-13-374930-4
ISBN 13: 978-0-13-374930-4

To those who hold high the candle that brings new light to education as exemplified by the credo of the Bank Street College of Education, written about 100 years ago by Lucy Sprague Mitchell . . .

What potential in human beings—children, teachers, and ourselves—do we want to develop?

- A zest for living that comes from taking the world with all five senses alert.
- Lively intellectual curiosities that turn the world into an exciting laboratory and keep one ever a learner.
- Flexibility when confronted with change and ability to relinquish patterns that no longer fit the present.
- The courage to work, unafraid and efficiently, in a world of new needs, new problems, and new ideas.
- Gentleness combined with justice in passing judgment on other human beings.
- Sensitivity, not only to the formal rights of the other fellow, but to him as another human being seeking a good life through his own standards.
- A striving to live democratically, in and out of schools, as the best way to advance our concept of democracy

We fervently hope that the models of teaching we open in this book will live up to her manifesto and keep her candle burning.

This page intentionally left blank

Contents

This book, *Models of Teaching,* is the central component in the multimedia system that supports the study of the major research-based approaches to teaching. However, two other components are very important.

The website **www.modelsofteaching.org** provides suggestions on ways of using the book and videos in courses, including online offerings and self-instruction. PowerPoints for each model and a variety of other materials are also available. These materials are designed for both instructors and students, providing support in the design of campus and online courses and for personal study.

The second component is our YouTube channel, which offers video demonstrations of many of the models of teaching, as well as several talks on models and how to learn them: **www.youtube.com/user/BooksendLab.** The site provides access to 25 video demonstrations of a variety of models as well as videos providing tips for learning each model.

Preface xvii

A Note on Heritage xxiii

PART ONE

MODELS OF TEACHING: A WORKING PROFESSIONAL REPERTOIRE **1**

The models are introduced briefly, along with ideas about how to build learning communities in classes and the school as a whole.

CHAPTER ONE

Where Models of Teaching Come From
Constructing Knowledge and Skill to Help Our Students Construct Knowledge and Skill **3**

The product of teacher-researchers comes to us in the form of models of teaching that enable us to construct optimal learning environments for our students. From the time of the academies in Greece and Rome,

teachers have generated innovative approaches to learning and teaching. Succeeding generations have given birth to additional ways of helping students learn. As teachers we can draw on these products and use them to help our students become effective and creative learners.

CHAPTER TWO

Building the Community of Expert Learners
Taking Advantage of Our Students' Capacity to Learn (and Ours) **21**

We celebrate learning and the virtues of social support for learning. Classes and student bodies need to be developed into learning communities and provided with the models of learning that enable students to become expert learners. We study how to build these communities, including developing hybrid approaches to teaching/learning, with the resources of ICT integrated with campus teaching. Increasingly, a community of learners will be made up of students from more than one venue, linked by electronic communication.

PART TWO

THE BASIC INFORMATION-PROCESSING MODELS OF TEACHING **35**

How can we and our students best acquire information, organize it, and explain it? Here are several models that are directly aligned with the new curriculum standards—frameworks that embrace teaching students with the methods of the disciplines underlying them.

As we remind ourselves continuously, a major outcome of these models is the development of capacity to learn, to collect and approach information confidently, and to help one another become a community of learners. The tools learned by finding and managing information support the social, personal, and behavioral families. Information-processing models provide academic substance to social models, ways of thinking for personal inquiry, and goals for many of the behavioral models.

CHAPTER THREE

Learning to Learn Inductively
The Really, Really Basic Model of Teaching **37**

Human beings are born to build concepts. The infant, crawling around, feeling things and bumping into them, observing people's actions and listening to them, is born to acquire information that is sifted and organized,

building the conceptual structures that guide our lives. The inductive model builds on and enhances the inborn capacity of human beings to organize information about their environments and build and test categories—concepts—that make their world more comprehensible and predictable.

This model is placed first in this part because many other models draw on it, and because when it is combined with others, particularly some social models (e.g., group investigation), student learning can be dramatic.

CHAPTER FOUR

Scientific Inquiry
Building Learning around Investigations **71**

From the time of Aristotle, we have had educators who taught science in the making rather than teaching a few facts and hoping for the best. We introduce you to a model of teaching that is science in the making. Today, students can identify a domain of study or problem, conduct investigations of their own, and connect to studies available on the web. Virtual investigations and simulations can shorten time and bring students into labs and field studies where complex equipment is available and faraway settings can be studied.

CHAPTER FIVE

The Picture Word Inductive Model
Developing Literacy through Inquiry **91**

Built on the language experience approach, the picture word inductive model enables beginning readers to develop sight vocabularies, learn to inquire into the structure of words and sentences, write sentences and paragraphs, and thus become powerful language learners.

PART THREE

SPECIAL PURPOSE INFORMATION-PROCESSING MODELS **123**

The models in Part Two can be used for some very broad purposes, including designing lessons, units, courses, and distance offerings. The more specialized models in Part Three, however, are designed specifically to:

- Teach concepts
- Teach students to memorize more effectively, including facts, concepts, and even the core ideas of philosophies

- Teach students to think divergently by learning to use synectics processes to make metaphoric comparisons to break set and learn unfamiliar material better, develop more solutions to problems, and build richer and more productive social relationships
- Design presentations with advance organizers, including lectures, media, and distance offerings
- Teach basic inquiry skills

CHAPTER SIX

Concept Attainment
The Explicit Teaching of Important Concepts **125**

Students can not only develop concepts, they also can learn concepts developed by others. Based on research on how people develop categories, concept attainment teaches students how to learn and use concepts and develop and test hypotheses. The authors have had a considerable role in developing variations on this model and applying them to a range of curriculum areas. This model is an important staple for teachers and students at all grades and a particularly interesting one for the design of online offerings where the teaching of concepts is central.

CHAPTER SEVEN

Synectics
Teaching the Left Brain to Put the Right Side to Work **149**

Creative thought has often been thought of as something genetically given to a special few, and something that the rest of us cannot aspire to. Not so. Synectics brings to all students the development of metaphoric thinking—the foundation of creative thought. The model continues to improve as we learn more about how to develop analogies to break set, understand better, and solve problems. Importantly, a long-term effect occurs as students learn how to generate fresh ideas and solve problems in their future lives.

CHAPTER EIGHT

Memorization
Getting the Facts Straight, Now and for the Long Term **173**

Memorization has had something of a bad name, mostly because of deadly drills and poorly designed textbooks and lectures. However, contemporary research and innovative teachers have created methods that not only improve our efficiency in memorization, but also make the process delightful. The research provides a variety of ways to design

presentations, readings, distance offerings, and on-campus inquiries that ease the way to long-term retention of key information.

CHAPTER NINE

Using Advance Organizers to Design Presentations
Scaffolding Lectures, ICT, and Distance Offerings **197**

Learning from presentations has had almost as bad a name as learning by memorization. David Ausubel developed a system for creating lectures and other presentations that will increase learner activity and, subsequently, learning. A scaffold provides a cognitive map of the material for students to organize their study and assess their progress. This is a particularly useful model for the design of distance learning packages. Students can learn to develop scaffolds as a part of their inquiries.

CHAPTER TEN

The Inquiry Training Model
Training Inquiry Skills Directly **213**

Here we have a nicely structured model that begins with puzzling situations and continues with exercises that teach students to ask questions and assay the responses they get.

PART FOUR

THE SOCIAL FAMILY OF MODELS OF TEACHING **229**

Working together just might enhance all of us. The social family expands what we can do together and generates the creation of democratic relationships in venues large and small. In addition, the creation of learning communities can enhance the learning of all students dramatically. Interestingly, collaboration among people in different settings is remarkably satisfying, as witnessed in the rise of social media. With respect to collaboration in academic learning, a vast network of systems is fast developing as people interested in particular things find colleagues who share their interests.

CHAPTER ELEVEN

Partners in Learning
Getting Everybody on Board **231**

Can two students increase their learning when paired? Yes. Will they develop better social and academic skills if they work together on projects? Yes. Can most students profit from training to collaborate? Yes. Do

collaborative classrooms increase productive study and time on task and decrease unproductive and disruptive behavior? Yes. Are cooperative learning models applicable to K–12 and across curriculum areas? Yes. This chapter looks at some of the basic, easy-to-implement forms of cooperative learning.

CHAPTER TWELVE

Group Investigation
Rigorous Inquiry through Democratic Process **243**

Can students organized into a democratic learning community learn to apply scientific methods to their learning? You bet they can. Group investigation can be used to redesign schools; increase personal, social, and academic learning among all students; and satisfy both learners and teachers. The project method is a recent variant that organizes students to attack specific social problems. The vast resources of the web are putting new wheels under the complex social models. And, online courses do not have to be presentation only or step-by-step drill. They can be designed with vigorous collaborative models, albeit at a distance.

CHAPTER THIRTEEN

Role Playing
Studying Values **257**

Values provide the center of our behavior, helping us get direction and understand others. Policy issues involve the understanding of values and the costs and benefits of selecting some solutions rather than others. In these models, values are central. Think for a moment about the issues that face our society right now—research on cells, international peace, including our roles in the Middle East, the battle against AIDS, poverty, and who controls the decisions about pregnancy and abortion, not to mention just getting along together.

PART FIVE

THE PERSONAL FAMILY OF MODELS **279**

The learner always does the learning. His or her personality interacts with the learning environment. How do we give the learner centrality when we are trying to get that same person to grow and respond to tasks we believe will enhance growth? And how can electronic connections be shaped so that they are not just a matter of arguing online, but reflection and

growth? Oddly, some kinds of distance counseling can be quite helpful. Virtual counseling will be a developing field.

CHAPTER FOURTEEN

Nondirective Teaching
The Learner at the Center **283**

How do we think about ourselves as learners? As people? How can we organize schooling so that the personalities and emotions of students are taken into account? Let us inquire into the person who is the center of the education process.

Nondirective methods can be supported through distance means. During the school years and later, students can be better connected to their teachers and counselors and supported as they reflect on themselves and take steps to build their self-esteem and ability to relate to others. Much of the support that students need when undertaking investigations involving ICT resources, including online courses and other types of distance courses, can be provided in a nondirective fashion.

CHAPTER FIFTEEN

Developing Positive Self-Concepts
Finding the Inner Person and Learning Self-Actualization **301**

If you feel good about yourself, you are likely to become a better learner and have a generally better quality of life. But you begin where you are. Self-concept is a likely avenue. The wonderful work by the SIMs group in Kansas has demonstrated what can be done to help students improve their self-images (and their achievement).

We are what we do. So how do we learn to practice more productive behaviors? This chapter explores some of the possibilities that are variations on themes developed by therapists, particularly Abraham Maslow, Carl Rogers, Erich Fromm, and Karen Horney from the heyday of innovation in psychology.

PART SIX

THE BEHAVIORAL FAMILY OF MODELS **313**

We enter the world of tasks, performances, and positive and aversive reactions. The study of how behavior is acquired has led to a wide variety of approaches to training. Here we will deal with some of the major behavioral models.

CHAPTER SIXTEEN

Explicit Instruction
Comprehension When Reading and Composing When Writing **321**

For a long time the teaching of comprehension seemed elusive, although reading without much comprehension is not actually reading at all. Then researchers began to study the skills that expert readers use and develop ways of teaching those skills to all students. The resulting model is generally referred to as *explicit strategy instruction*.

CHAPTER SEVENTEEN

Mastery Learning
Bit by Bit, Block by Block, We Climb Our Way to Mastery **331**

This is the fundamental training model, where new content and skill are introduced, modeled, practiced, and added to the working repertoire. Planning and assessment are the complex parts of the model, but the investment pays off handsomely.

CHAPTER EIGHTEEN

Direct Instruction
Applied Psychology Goes to Work **339**

Why beat around the bush when you can just deal with things directly? Let's go for it! However, finesse is required, and that is what this chapter is all about. The basic model here is derived from social learning theory. Many distance models—a good deal are of the online variety—are direct, but several need better designs and students need to learn how to use learning strategies to get the most out of them.

PART SEVEN

THE CONDITIONS OF LEARNING, LEARNING STYLES, AND CONCEPTUAL LEVELS **349**

Even young children develop learning styles that interact with their environments, including the kinds of teaching they are exposed to. Major

types of learning, like identifying and perfecting new ways of learning, involve some degree of discomfort. Learning new material is a product of the school environment and students need to learn to cope with this discomfort or they will, inevitably, hide from new content. We explain the use of conceptual systems theory to match students to models and scaffold them toward integrating information that advances their growth.

We summarize the growing lines of research and suggest ways that every teacher can add a bit by teaching from an action research perspective, and we discuss and apply Robert Gagné's marvelous framework for applying research to the task of building curricula.

CHAPTER NINETEEN

Creating Curricula
The Conditions of Learning **351**

Robert Gagné's framework still guides us as we develop effective curricula. His groundbreaking work combined research on levels and types of learning with the problem of designing instruction that builds on how we think and build knowledge.

CHAPTER TWENTY

Expanding Our Horizons
Making Discomfort Productive **363**

By definition, learning requires knowing, thinking, or doing things we couldn't do before the learning took place. Curricula and teaching need to be shaped to take us where we haven't been. The trick is to develop an optimal mismatch so that we are pushed but not overwhelmed. Vygotsky popularized the term *zone of proximal development* to refer to content, conceptual understanding, skills, and processes that are just beyond our current development but not so demanding that we get lost. These concepts are very important because content and process that are well within our comfort zone, while soothing, do not challenge us to grow.

APPENDIX: PEER COACHING GUIDES 379

References and Related Literature 421

Index 447

This page intentionally left blank

Preface

Models of Teaching connects educators—new and experienced teachers, school and district administrators, school and literacy coaches, providers of professional development, and college educators—to a storehouse of well-developed and studied ways of teaching. These models have strong rationales, use different lines of research, and provide expected student learning examples. All of them are informed by the experience of the hundreds of educators who have used and refined them. Thus, the models represent a base for professional teaching—*professional* meaning "using research to guide practice."

Years ago many educators expected that research on teaching would result in a single model that was superior for all types of educational objectives. However, that was not the case when Bruce Joyce began writing *Models of Teaching*, and it is not the case today. Excellent teaching is made up of a repertoire of models that are very good for particular purposes but need to be assembled to generate a top-drawer learning environment for our students. In other words, teaching is not a one-dimensional operation. Rather, teaching reaches toward different students and across disciplines, responsible for a panoply of standards that require corresponding sets of teaching strategies and ways of reaching students.

Even today some policymakers hope that research will boil down the characteristics of effective teaching into a few principles. Though there are, in fact, some things that we all should do as teachers—and other things we should avoid—the kinds of teaching that will make the most difference to our students and give them the skills for lifelong learning are embodied in teaching strategies or models that provide those skills.

Although the comparison of various professions to medicine is somewhat shopworn, there are important parallels here. In medicine, we don't have one antibiotic, one regimen, one type of test. Furthermore, some medical specialties are directed toward prevention as well as treatment. Complicating the assessment of both preventive measures and treatment is that interactions are probabilistic. Obesity is bad for the heart, but some thin people have heart trouble. In education we have models that help students learn how to think more clearly, to organize information better, to feel more confident—but like medical treatments, educational treatments are probabilistic. Education is not

like a game of billiards, where a properly struck ball goes where it is supposed to all the time. In our case, it is *most* of the time.

Over the last 30 years, three important developments have enhanced teaching. One is the continued research on particular models and the development of new ones. Refinements have enhanced their effectiveness. The second is the development of combinations of models into curricula that have great power. Third is the development of electronic technologies that enlarge the library and bring massive amounts of information into the classrooms of even the youngest children. In modern classrooms, hundreds of physical books—fiction and nonfiction—surround the students, and electronic media access to vast resources provides encyclopedias and dictionaries that represent a real advance over print media. The Internet connects modern classrooms to a global network. The study of history is supported by original documents that are easy to access, including graphic material such as the 1,000,000 photos in the Library of Congress collection (www.loc.gov). NASA provides information about space exploration that was available to only a few insiders a dozen years ago. ScienceFriday.com is a delightful site for students and teachers, with simulations available to incorporate into units and courses. Email enables any class to be connected with classes in many of the countries of the world. Young children can follow Jane Goodall's career from her earliest studies to the development of the worldwide organization of children and adults who work together to create a better environment for all living things (including ourselves).

A note on information and communication technology (ICT) promises and worries: Everybody can profit by reading *The Shallows* (Carr, 2010) and *Smarter Than You Think* (Thompson, 2013). Carr lays out the worries that ICT will have seriously negative effects on certain skills and habits. For example, is the use of GPS navigation systems eroding skills in understanding and using maps? Can habitual web-surfing, tweeting, and texting friends generate a goalless, immediate-gratification-oriented state of mind? Or, on balance will the new activities generate new skills and intelligences? This debate will go on for some time.

In our case, we have come from writing manuscript on yellow tablets and typing the result with gallons of corrective fluid on hand. From there, the process evolved to writing and communicating with editors with word processors and graphics files. And at present the print book is also an ebook and is backed up by www.modelsofteaching.org, which brings materials for instructors and students and leads readers to video demonstrations of models, talks providing tips for learning them, PowerPoint tutorials, and more. You don't just write, today, you relearn how to write.

However, as teachers, we need to teach the models of learning that enable our students to understand and exploit the web and use the communication channels to inform themselves and create global connections where interaction with other societies and their cultures becomes the new normal.

The newly developed science frameworks and literacy standards are greatly improved over their predecessors and provide direction for K–12 teaching and learning. Thus, developed models of teaching can become even more effective because support materials, both print and electronic, have become richer.

Yet the field of education is being fiercely criticized at this time in history. Governmental agencies are pressing schools with unprecedented force because current examinations of student learning, particularly the national studies of educational progress, have indicated serious problems. One such problem is that a third or more of our students are not learning to read and write effectively. How can that be, when teaching strategies and learning resources are developing so well?

A major reason is that those powerful models of teaching are unknown to many educators. They need to be known, learned, and used. This book and the resources connected to it can enable new and experienced teachers to broaden their repertoires, develop rich curricula, and enable all students to succeed. All these models work well with students who come to school with limited backgrounds and knowledge of the English language. Our cause is passionate. Education is not only present life; it is also the life of the future. As time passes, all of these models of teaching will be radically changed or replaced by better ones. For now, let us give the students the best that we know.

What students learn today affects their lives in the long term. When we teach our children to read, we are helping them become lifelong readers. When they are learning to work together, they are becoming collaborative citizens of our democracy. When they learn science, they are developing the inquiry skills and habits to educate themselves and solve current and future problems.

Teaching is helping people create themselves. The effects of a teacher's work are still maturing a half-century or more after students' formal education is completed.

New to this edition

This edition is enhanced by productive changes in the written prose, the addition of pictures depicting the teaching/learning process in action, and multimedia dimensions where video demonstrations are integrated with the print book.

Multimedia additions include:

- Integrated demonstrations of models of teaching. The demonstrations were captured in classrooms where expert teachers used the models of

teaching with their students. These can be streamed on demand by both instructors and students.
- The website, www.modelsofteaching.org, which extends additional support to learn the models of teaching with PowerPoint presentations, application guides, and video talks.

Text updates include:

- Newly developed analyses of research and applications of the models. Approximately 30 percent of the prose is new to this edition.
- Applications which demonstrate current policy for school improvement. The models in the book are essential to the implementation of the new Common Core State Standards.
- Updates which shape this book into a core text of Professional Learning and School Improvement Initiatives.
- References to lines of research which constitute the field of education can be found within the text and online at www.modelsofteaching.org. The 9th edition provides an extensive guide for graduate study in education.

Acknowledgments

Bruce and Emily cannot thank these folks enough.

Lisa Mueller has been a wonderful professional partner. She is a fine provider of professional learning opportunities and demonstrations. We have made videos of her marvelous demonstrations, and they are used in many professional learning programs. Her work has provided inspiration for this edition of *Models of Teaching*.

Brendan Joyce is a great personal companion and has generously given us his technical competence. The site modelsofteaching.org contains manuals, peer-coaching guides, bibliographies, and papers on a number of topics related to this text. The site leads to our storehouse of video demonstrations and links. These and our blog, which enables readers to talk with us, are among Brendan's contributions.

Lori Kindrachuk, Ralph Kindrachuk, Marilyn and Walter Hrycauk, Ed Witchen, Jim Jutras, and Kim Newlove have been wonderful companions in the organization of our recent Canadian excursions in school enhancement through professional learning.

Grant Dougall, Sharon Champ, and Mary Bishop are enjoyable friends and colleagues and worked with us to develop videos and other materials. For a sample of Mary's books, take a look at *Tunnels of Time* (2000).

Maureen Bezanson, Jordan Carlson, Tracy Poirier, and Nicole Simon taught us a lot as they studied several models and the Read to Succeed curriculum. They enriched our understanding as we worked with them to introduce several hundred teachers to those innovations.

From Pearson we have had fine support from editors who were given the responsibility for this edition. Both Linda Bishop and Meredith Fossel took over as editors and worked as if *Models of Teaching* were one of their new acquisitions. Janet Domingo has managed the production with knowledge, skill, and good-humored determination. She has a dynamic interface with the helpful Katie Watterson of Electronic Publishing Services Inc. Heather Gauen Hutches, the copyeditor, has been a content and stylistic editor as well as setting up the copy for the compositors. She is a real editor in all senses.

Bruce Joyce
Emily Calhoun
Saint Simons Island, GA

This page intentionally left blank

A Note on Heritage

THE FIRST 2000 YEARS

This is a sketch, really a reminder, that the development of universal public education is a relatively recent event—in fact, one that is not yet complete. Its emergence is built on the work of serious social thinkers and visionaries that shaped the cultural readiness on which equity in the opportunity to learn can be pursued.

The development of formal education depended on the development of language, although long before language developed there was communication—and teaching. Parents, relatives, and tribe members passed down the tools and lore of their culture. Even taboos, such as incest, were enculturated. But with literacy, many aspects of the culture could be written down and passed on more uniformly. Even when most of the citizens were not literate, the written words could be read to them. Scribes wrote down the words of political and religious leaders so that those words became available not only to current citizens but also to subsequent generations.

The development of reading, writing, and some types of formal schooling began long ago, even where only a small portion of society had access to literacy. The Egyptian alphabet dates from about 3500 B.C. Chinese writing included about 2500 characters by around 1200 B.C. Extensive written works in India date from about 800 B.C. Hebrew writing began a few centuries B.C.

The formal literature on Western education dates from the ancient Greek and Roman educators. Some still-useful models have been around for centuries. Plato and Aristotle both developed models of teaching—Socratic dialogue on the one hand and inductive inquiry on the other—that have validity today. Study the literature from their day to the present and you will find a variety of innovative educators who have contributed useful conceptions of teaching and learning. In any given era, there were only a handful of leaders who were able to leave a written heritage, but we have access to them. In their time, their reflections on educational needs in their societies and how to meet

them generated discussions that continue to the present day. Consider just these examples:

- John Amos Comenius (1592–1670) was a Czech religious and educational leader who advocated universal education to provide high qualities of living for individuals and collective knowledge for the improvement of society.
- Jean-Jacques Rousseau (1712–1778) was a French philosopher who also advocated an education to enable all citizens to reach their potential and build a strong base for social improvement. His book *Emile* feels remarkably relevant today, as does writing by his contemporary, Voltaire, whose satirical *Candide* (1759) advanced the development of the novel. Both were influential and productive musicians as well.
- John Locke (1632–1704) was one of a number of important British scientists/philosophers/political activists. He was one of the influential spokesmen for using empirical and logical thinking and scientific methods to seek knowledge and verify ideas. His advocacy of education was closely connected to his beliefs that democratic, rather than authoritarian, processes should make up the social contract and that education for all would underpin democratic behavior and institutions.

In the United States, a number of voices addressed education during the period that led up to independence and the agreement on the Constitution. Benjamin Franklin and Thomas Jefferson represent a small but important group whose talks and writings generated discussions that continue to the present day. Both believed that education should be universal. Jefferson developed a very specific framework where progression through the levels of education would be based on merit. Interestingly, all of the persons we have mentioned thus far came from societies where they had access to education and learning from the most highly educated people of their time—and across national borders. Their belief in a truly democratic society was intertwined with their belief that universal education was an essential condition of democracy. They set forth the arguments for their position along with their beliefs that knowledge should be based on reasoned argument and empirical inquiry rather than on superstition, tradition, or rhetoric. These ideas were the basis for the political action to create the educational system of nations and communities. Finally, in fits and starts, universal education came to life—and actually *is still coming to life*.

The development of a formal educational literature, one that could be taught to educators, began in the 1800s. When the common school in the United States began to develop in earnest—1830 is an approximate birth date—much of public education was dominated by a relatively dour view of childhood. A drill-and-practice mode prevailed, backed up by a "spare the rod and spoil the child" belief in harsh discipline. Much of the early formal writing was in reaction to

unpleasant and inefficient educational practices. Horace Mann (1796–1859) was a powerful advocate for a more positive view and for methods of teaching that would be more consonant with how knowledge is generated and that would incorporate social processes more aligned with life in a democratic society.

The works of Henry James (1842–1910) and John Dewey (1859–1952) provided the base for modern research and development in education. James was a physician and physiologist; he is regarded as the father of psychology as a discipline. Dewey combined ideas from his own work and that of others to form a different vision of education, specifically educating future citizens by organizing learners into collaborative groups that were taught to use scientific inquiry and disciplined discourse as basic tools for learning. These two men represent the beginning of formal inquiry into education, and their works are influential to the present day.

Modern empirical educational research: building and testing models of curriculum and instruction

By the 1920s, there was a community of researchers in education and philosophy who established educational research as a discipline. By the late 1950s, there were a significant number of researchers and inventors who used empirical methods to validate the curricula and models of teaching they were creating, while the social and behavioral sciences contributed methodologies that enabled the inventors of new models to assess them and make them more effective. Much of our current heritage of approaches to teaching and learning are grounded in rationale and empirical work that has occurred in the last 90 years, although they owe a major debt to prior ideas and inquiries.

Our contemporary storehouse of models is grounded from basic and applied research conducted from the mid-1930s to the present—the modern period of research on education. The sets of studies built around movements to create models of teaching derived from the academic disciplines, particularly the sciences and mathematics, and inductive thinking processes constitute a strong line of work that continues to the present. We selected this line of work because so many models draw on it, although each model has its unique set of inquiries that we will discuss in the chapters introducing them.

Because a considerable amount of research on teaching and curriculum has been connected to the academic disciplines, particularly the biological, physical, and social sciences, we can see bursts of innovative activity and research in terms of three phases of the Academic Reform Movements, in which bringing scientific concepts and processes into education were central. The first phase took place from the late 1950s until about 1985. The second phase occurred between 1985 and 2008 and built on the first movement. We

are entering the third phase now, as the National Research Council (2012), comprised of members from the National Academy of Sciences, the National Academy of Medicine, and the Institute of Medicine, has published its framework for K–12 science standards (www.nap.edu). The National Academy was initiated in the 1860s to make scientific knowledge available to advise policymakers and provide information to the general public. Influential in the first phase of the Academic Reform Movement in education, its descendants are initiating the third phase.

The First Phase of the Academic Reform Movement

Studies at the Secondary Level

A set of meta-analyses of more than 300 studies on science curriculum and teaching was coordinated at the University of Colorado (Anderson, Kahl, Glass, Smith, & Malone, 1982). Taking into account that the research on science teaching is complex and studies vary considerably in their objectives and conduct, a persistent focus was on the effect of efforts that are characterized within cooperative/inductive inquiry. Particularly, did students acquire information, build and study data sets, form concepts by organizing and analyzing information in those sets, and engage in investigations (formulate questions, devise methods, and study results)? Put another way, did the students learn academic content and processes for solving problems by studying science content with empirical methods and engaging with the inductive processes that cross curriculum areas?

Ronald D. Anderson (1983), a senior researcher at the Laboratory for Research in Science and Mathematics Education at the University of Colorado in Boulder, summarizes concisely the results of the sets of studies: "Pertinent information from four of the meta-analyses is discussed here and, in general, points to a positive vote for inquiry teaching" (p. 500). Anderson, however, was concerned about the extent that inquiry methods are actually implemented in long-term curricular implementations. He points out that in the Shymansky, Kyle, and Alport (1983) meta-analysis of 105 studies (1000 classrooms with, conservatively, 150,000 students), degrees of use of inquiry methods did not generate differences in effects. However, even in the control groups, *all* of the curricula studied were based on science content and processes, and most of the studies were of six months or more, so differences of degree may not be large.

Studies at the Elementary Level

In addition to the set of University of Colorado studies, Bredderman (1983) pulled together the studies of the inquiry-oriented, hands-on science curriculum at the elementary level.

Bredderman drew on research on three "activity-based" programs funded through federal resources and assembled by scholars in education, scholars and district consultants in the sciences, and teachers. The three programs varied considerably in structure, with the Elementary Science Study being the most open ended and *Science: A Process Approach* being the most structured. None were structured around textbooks in elementary science. Students acquired data largely through observation and experimentation. Among the three programs, there were 57 controlled studies reported over a five-year period, involving 900 classrooms and, conservatively, about 13,000 students. Two-thirds of the studies involved 10 or more classrooms. Half of the studies were a year or more long, and most lasted two years or longer.

The mean effect size for learning science processes was 0.52. The effect size for scientific content was 0.16. Attitude toward science and process was 0.28. Smaller subsets examined effects on creativity (0.42) and measures of intelligence (0.48). Computation and mathematical understanding increased modestly. The aggregated mean effect size was 0.30.

> The idea that curriculums should aim at ideas, inductive and other scientific processes, and intellectual capacity and creativity is quite different from the position that the fundamental purpose of education is to imbue students with basic information and skills. One of the often-heard reactions to the activity-based programs has been that they put too much stress on science process at the expense of content learning. However, when activity-based programs are compared with traditional science programs on standardized achievement tests, it appears that those fears have been unwarranted. Content achievement was not affected in a negative way. This was true even if only a subgroup of studies that compared textbook programs with activity programs was considered. (p. 512)

The Second Phase of the Academic Reform Movement

Over the next 20 years, research on inquiry teaching continued, and in 2010 Minner, Levy, and Century presented a synthesis that covered 138 studies from 1984 to 2002. Nearly 2000 classrooms and about 40,000 students were involved.

Like Anderson 27 years before them, Minner, Levy, and Century are able to make a definitive statement about the effectiveness of the inquiry-based science curriculum during what we characterize as the second phase of the Academic Reform Movement.

> Findings . . . indicate a clear, positive trend favoring inquiry-based instructional practices, particularly instruction that emphasizes students' active thinking and drawing conclusions from data. Teaching strategies that actively engage

> students in the learning process through scientific investigations are more likely to increase conceptual understanding than are strategies that rely on more passive techniques. (p. 474)

Generally speaking, the results from the Minner, Levy, and Century synthesis are somewhat larger than the results from the studies associated with the Academic Reform Movement. Probably this is a result of the increased refinements in curriculum and instruction—and we can expect more.

The Third Phase of the Academic Reform Movement: Just Beginning

The National Academy of Science's *Framework for K–12 Science Education: Practices, Concepts, and Core Ideas* (National Research Council, 2012) provides the conceptual foundation for the next core curriculum in science and will generate a third phase of the Academic Reform Movement. The inclusion of engineering and technological content should enhance content and process significantly. From the 40 years of studies drawn on previously, we can predict that not only the teaching/learning process will be upgraded, but that student learning will also rise to new levels.

The authors of the framework recommend even more powerful curricula than their predecessors. The development of hybrid curricula that draw on ICT and the increased use of interactive electronic media in and out of school should increase the use of investigation as part of the curriculum. There is now ample evidence that the success of ICT in education will depend on the models of teaching and learning that are implemented.

PART ONE

Models of Teaching: A Working Professional Repertoire

Chapter 1 opens our inquiry. We examine the concept of models of teaching and learning and how the models in this book were selected. We begin to study where models have come from—from gifted teacher-innovators is the short answer—and we prepare to acquire these interesting and effective tools. In Chapter 2, we delve into the social aspects of learning, for effective teaching involves the development of communities of learners and equipping students with ways of learning that will enable them to have high quality lives in school and beyond.

This page intentionally left blank

CHAPTER ONE

Where Models of Teaching Come From

Constructing Knowledge and Skill to Help Our Students Construct Knowledge and Skill

Helping new teachers learn to help students learn is more than worthwhile. It's transporting. The satisfaction when the veil lifts and someone realizes that the only barriers to growth are imaginary and self-imposed is almost unbearable. It's like watching the birth of a species.

—Fritz Perls to Bruce Joyce

ORGANIZING IDEA

Effective teaching is made up of a toolkit of ways to reach students and help them build their reservoir of knowledge, skills, and enduring values.

SCENARIO

A DAY IN THE LIFE OF SECTION 3A IN SIMONS ELEMENTARY SCHOOL

8:30. Traci Poirier's third-grade students assemble and find their places in the big horseshoe where their desks are arranged. This week they are organized in groups of three. The members of each group discuss something they have done or thought about since leaving class yesterday. Some share books they have read, films or television programs they have seen, places they have gone, or conversations with their family. All are responsible for sharing some current news event.

8:45. Traci asks whether any students wish to share an item that was shared with them. Nancy shares that Billy had received an email from his pen pal at Taipei Market School in Hong Kong (their recently adopted class, which uses them to

study life in the United States as they study life in Hong Kong). Billy's pen pal has wondered how many brothers and sisters they have. Everyone writes down his or her number of siblings and passes it to Billy so he can reply. Andy shares that Sharon reported that her sister was getting married on Saturday and wonders whether the class could send her a "best wishes" card. They agree to do so, and Andy volunteers to make a card to send to them.

9:00. The class begins their literacy study. The first inquiry is to get information from a picture of downtown Taipei Market. The class members take turns identifying items in the picture. Traci draws lines from the items to chart paper that surrounds the picture and writes and spells the words, and Andy enters them into the computer. Later they will be printed out on cards for each member of the class. About 30 items are identified and 12 questions generated.

The words are then compared with a set of items they have generated from a picture of the downtown area in their town. To their amazement, about 20 words from each picture are the same. There are more common attributes than different ones. Only six items in the Taipei Market picture are unfamiliar to them. Some of the items are similar, although their representations may be different (a sign in Chinese and English contrasts with a sign only in English). Traci agrees to circle them on the digital picture and email it to the Hong Kong class for identification.

9:30. The class does independent reading. For most students this means reading information from websites that Traci has bookmarked for them and looking through the encyclopedias for information about Hong Kong, taking notes, responding to questions, and developing new questions to explore. Traci tests two students using the Gray Oral Reading Test, looking for fluency and comprehension and searching for clues for her next sessions on comprehension skills for all the students.

10:00. The class works on writing, comparing the two downtown areas using the words they have identified to describe the two pictures. Traci models opening sentences for them, concentrating on how titles and first lines work together to establish topic and theme. She picks up on a prior session where the students classified opening sentences in trade books. Tomorrow they will continue to gather and discuss information as they compare Hong Kong to their own locale, and they will use synectics (see Chapter 7) to explore analogies to structure their writing.

It's only 10:30, but Traci has already designed activities using cooperative learning strategies, the picture word inductive model, group investigation, and the inductive model, and has planned a follow-up lesson using synectics. As the day progresses, she will begin a unit on plants in their vicinity, using the scientific

inquiry model (Chapter 4), and continue a unit where the properties of number systems are the focus.

Traci has a good-sized repertoire of models of teaching. She knows that success for the students depends on their mastery of the models of learning that are embedded in each model of teaching.

The classic definition of teaching is *creating environments to facilitate learning*. A model of teaching is a way of building a nurturant and stimulating ecosystem within which the students learn by interacting with its components. Various models pull students into particular types of content (knowledge, values, skills) and increase their competence to grow in the personal, social, and academic domains. We use models in many ways, ranging from planning and using lessons, units, and curricula, to designing instructional materials, including multimedia programs. This concept replaces the "gas station" image of education, where students drop by to be loaded with cognitive fuel. That rather obsolete picture of teaching emphasizes the time-honored picture of a person *imparting* knowledge or skill by talking, exhorting, and drilling students—taking them through their paces in a grinding fashion. Happily, there are models for designing and delivering good lectures, motivating students, and carrying out effective training. There are times when we need to use the traditional delivery or transmission modes, but when we do, we should use the best models available for designing learning experiences and always be aware of the purposes that any approach can and cannot fulfill.

The last few decades have generated an enormous number of ways to enhance learning environments that existed only in dreams when we were writing the first edition of *Models of Teaching*. Even then we were using film, video recording and playback, simulations, transparencies, a dozen or so models of teaching, and a variety of other technologies both in our school and our teacher education programs. Those media are still important, but some are still underused in schools and universities. The best models of teaching in the earlier era are still effective today, along with some new ones, and all are enhanced by information and communications technology (ICT) and the available digital education tools.

Our Personal and Professional Heritage

We have been fortunate enough to study with many contemporary educators who have developed and tested a variety of approaches to education and have developed the literature from the 1960s to the present. You will meet some of these shortly. We visit schools and classrooms and study current research on teaching and learning. We also study teaching in settings other

than K–12 schools, such as therapies and training in industrial, military, and athletic settings.

We have found models of teaching in abundance. Some have broad applications, whereas others are designed for specific purposes. They range from simple, direct procedures that yield immediate results to complex strategies that students acquire gradually from patient and skillful instruction.

For *Models of Teaching,* we selected models that constitute a basic repertoire for schooling. With these models we can accomplish most of the common goals of schools—and at a high standard. In any school, students can achieve many goals that only outstanding students in outstanding schools once aspired to achieve. Using models in combination, we can design schools, curricula, units, and lessons. The selection includes many, but not all, of the major philosophical and psychological orientations toward teaching and learning. All have a solid theoretical basis—that is, their creators provide us with a rationale that explains why we expect them to achieve the goals for which they were designed. The selected models also have histories of extensive practice behind them: They have been refined through experience so that they can be used comfortably and efficiently in classrooms and other educational settings. Furthermore, they are adaptable to the learning styles of students and to the requirements of many curriculum areas. Education comes to the new core curriculum standards with a well-stocked storehouse of effective models that address the most demanding standards.

In addition to being validated by experience, all are backed by formal research and disciplined action research that tests their theories and their abilities to yield positive effects. The amount of related research varies from model to model. Some are backed by a few studies; others have hundreds of items of research. As we discuss each model, we provide key references and links—ones that provide access to the research literature and will include page-long descriptions of some of the more revealing studies. They were designed to have positive effects on student learning, and we try to make the warrants (evidence and reasoned analysis) under their stated effects as transparent as possible.

Common Characteristics Across All Models

Before introducing the models and the families into which we have grouped them, we need to discuss some of the characteristics that all of the selected models share. Learning is the reason for all models, but other attributes are common and integral to the teaching stances represented by the models.

Helping Students Learn How to Learn

In their own fashions, each of the selected models includes helping students increase their repertoire of strategies for learning. While using any model, teachers study how the students learn and help them expand their capacity to do so.

• **Helping students take responsibility for learning and supporting their efforts.** Even when being highly directive, which can be the case while introducing students to new ways of learning, we emphasize that they need to build the capacity to take increasing responsibility for their learning. We move from a need to provide extensive coaching to students to a situation where students are coaching themselves.

• **Helping students reach toward new knowledge, skills, and self-understanding.** The essence of learning, in school and out, is acquiring new cognitions, abilities, and even emotions and values. A major part of teaching is helping students learn to go beyond where they are. When a six-year-old says, "I don't like to read!" the underlying emotion is that the child wants to avoid the labor of learning to read and, possibly, the feeling of embarrassment while overcoming difficulties in learning.

A Constructivist Orientation

In their own fashions, all these models seek to help students build knowledge, skills, and values. The instructional aims of several models are almost purely constructivist with respect to academic content (see Vygotsky, 1962). For example, inductive inquiry (Chapter 3) designs the environment so that the student *constructs* categories, tests them, and from them generates inferences and hypotheses, leading to more testing. A very different model, nondirective teaching (Chapter 14), is designed to help students understand themselves better—to *construct* self-knowledge—and set goals in the personal, social, and academic domains.

Scaffolding the Learning Process

Built into their processes, all the selected models provide avenues for teachers to "boost" students over difficulties and into the next levels of learning. Vygotsky described the process as seeking the "zone of proximal development" where learning tasks are at a level slightly above the student's zone of complete comfort, but not so far above that the student cannot manage. Conceptual systems theorists, including the present authors, describe this as providing an "optimal mismatch" designed to enable students to pull themselves into ever-higher levels of capability (see Chapter 20). For example, when teaching new skills with the "training" models (as in Chapter 18), a skill is explained and demonstrated and then the student has to try the skill. At that point, if a student shies away, scaffolding in the form of encouragement may be enough to lift them to try. Possibly more explanation or another demonstration may be in order, but providing motivation may be the difference between success and discouragement. Scaffolding by a teacher on the campus can be a critical support when a student is engaged in distance learning, such as taking part or all of a

course online. More than ever, students need to learn to profit from distance offerings. Even those who are highly skilled at downloading and learning to play games may need help when downloading large quantities of information.

Formative Assessment and Adjustments

Closely related to scaffolding is the use of formative assessment to determine whether more or a different kind of support is needed. Sometimes switching to a different model of teaching can help a student find an avenue to learning. ICT is an increasingly important resource for classes as a whole, as well as providing acceleration for students who are sprinting ahead and tutoring for those who need extra help along the way. Helping students become aware of their progress and needs is a critical component of formative assessment. Parents are also brought into the process when they can help, which is frequently.

All models of teaching provide the opportunity for teachers and students to study progress, continue things that are working well, and make adjustments by adding processes and replacing ones that are not working.

21st-Century Skills

A strong movement to improve education has emphasized what have been termed *21st-century skills*—types of expertise that have come to the fore as the global, digital world has emerged. Probably "areas of needed knowledge and competence" is a more accurate and useful term than "skill," but expertise is certainly found in them (see Kay, 2010; Joyce & Calhoun, 2012).

Some 21st-century skills are versions of competence that have been around for a while. Some have been emphasized in the new core state standards, and some are emerging as the digital age ripens. They are *not* just a collection of computer or ICT skills. Though ICT literacy is important, the vital skills are cognitive: learning to inquire, to build and test ideas, to categorize, to summarize. These have been with us a long time, and they continue to be essential as the opportunities to use them expand. However, everyone needs the skills to use software for word processing, graphics, photo and video editing, searching the web, and locating and using distance instructional offerings. For teachers, mastery of interactive whiteboard technology is increasingly important. Let's look at some of the other areas that are emphasized by the 21st-century movement.

Cultural Literacy and Global Awareness

One of the most striking characteristics of the ICT explosion is the rise of a global, cross-national culture and its effects on relations near and far. These effects change the nature of our society, increase interdependence, and generate a considerable need for intercultural understanding. The implications are apparent as nations and their well-being have become more interdependent,

economies more unified; and we as individuals are in contact with, well, almost everyone. A provincial perspective today can have devastating consequences.

Collaborative and Cooperative Skills

We need each other. We always have, but the price of failure to work with others near and far has become unsustainable. Schools need to develop a rich culture to teach students to work and play together. In fact, the campus will be a very important place in the future because it is the major social laboratory for the young. As they reach out into cyberspace and information and ideas zip back from global sites, students need each other for perspective. The simpler cooperative learning models must pervade the school, and the most complex models—cooperative/inquiry models and group investigation—should propel major inquiries. Social media have enormous implications and are affecting life all over the world.

We urge teachers to join the International Association for the Study of Cooperation in Education. We greatly enjoy and learn from their newsletter.

Creativity

Convergent thinking enables students to focus on and drive for mastery of knowledge and skills from outside. Divergent thinking plays with information, concepts, pictures, sounds, and objects. Things are moved around, and surprises appear. The process is what the great Bill Gordon called *serious playfulness,* an oxymoron that captures the essence of metaphoric thinking. Ideas that were born on different cognitive planes are placed next to each other, on top of each other, inside each other. Environments populated with analogies lure students into a divergent state. Conception occurs.

The selected models in this book share these characteristics and goals.

The Families of Models

We have grouped the models of teaching into four families whose members share orientations toward human beings and how they learn. These are:

- The Information-Processing Family
- The Social Family
- The Personal Family
- The Behavioral Systems Family

We turn now to these four families, what they emphasize, and the models and the people who invented them, studied them, and advocated for them. As you read, keep in mind that, as a teacher, you can begin with a few that have wide applicability and then add others to reach particular goals more readily.

The Information-Processing Family

Information-processing models emphasize ways of enhancing the human being's innate drive to make sense of the world by acquiring and organizing data, sensing problems and generating solutions to them, and developing concepts and language for conveying them. Some models help the learner find information and build concepts and hypotheses to test. Some emphasize teaching concepts directly. Some generate creative thinking. Others teach the processes of the disciplines that underlie the core subjects. All are designed to enhance general intellectual ability.

Eight information-processing models are discussed in Part II and III. Part II is focused on three broadly applicable models and Part III on more narrowly oriented "special purpose" models. Table 1.1 displays their names and the primary developers and redevelopers of each. In some cases, dozens of research-practitioners have contributed to the creation and renewal of particular approaches to teaching.

Inductive Thinking (Chapter Three)

The ability to analyze information and create concepts is generally regarded as the fundamental thinking skill. Although the model has been discussed since ancient times, the contemporary literature was given movement by the work of Hilda Taba (1966) and contemporaries who studied how to teach students to find and organize information and to build and test hypotheses. The model has been used in a wide variety of curriculum areas and with students of all ages—it is not confined to the sciences. Phonetic and structural analysis depend on concept learning, as do rules of grammar. The structure of the field of literature is based on classification. The study of communities, nations, and history requires concept learning. Even if concept learning were not so critical in the development of thought, the organization of information is so fundamental to curriculum areas that inductive thinking would be a very important model for learning and teaching school subjects. The model as presented is based on the recent adaptations by Joyce and Calhoun (1996, 1998), and Joyce, Hrycauk, and Calhoun (2001) in programs designed to accelerate student ability to learn.

This model is listed first because inductive processes are such an important dimension of cognition and cognitive ability, because it inevitably leads to cooperative study and action, and because it combines well with other models.

Scientific Inquiry (Chapter Four)

The National Academy of Sciences has produced a marvelous document that sets forth a forward-looking framework for K–12 science curriculum and teaching. Its comprehensive scope and readable style make it a fine resource for teachers of all grade levels and in all science areas. The inclusion

TABLE 1.1 Information-Processing Models

Model	Developer (Redeveloper)	Purpose
Inductive thinking* (Classification)	Hilda Taba (Bruce Joyce)	Development of classification skills, hypothesis building and testing, and understanding of how to build conceptual understanding of content areas
Scientific inquiry*	Joseph Schwab and many others	Learning the research system of the academic disciplines—how knowledge is produced and organized
Picture word inductive*	Emily Calhoun	Learning to read and write, inquiry into language
Concept attainment*	Jerome Bruner Fred Lighthall (Bruce Joyce)	Learning concepts and studying strategies for attaining and applying them; building and testing hypotheses
Synectics*	William Gordon	Help break set in problem solving and gain new perspectives on topic
Mnemonics*	Michael Pressley Joel Levin (and associated scholars)	Increase ability to acquire information, concepts, conceptual systems, and metacognitive control of information processing capability
Advance organizers*	David Ausubel (and many others)	Increase ability to absorb information and organize it, especially in learning from lectures and readings
Inquiry training*	Richard Suchman (Howard Jones)	Causal reasoning and understanding of how to collect information, build concepts, and build and test hypotheses
Cognitive growth	Jean Piaget Irving Sigel Constance Kamii Edmund Sullivan	Increase general intellectual development and adjust instruction to facilitate intellectual growth

*Indicates a model that has a full chapter or section in this text

of material from engineering and technology make applied science more prominent than in the past and their "cross-cutting concepts" that look across the disciplines are an important contribution to curriculum thought. A good place to begin is the website http://nextgenscience.org.

Social sciences also take a similar approach to curriculum and teaching.

The Picture Word Inductive Model (PWIM) (Chapter Five)

Developed by Emily Calhoun (1999), this model was designed from research on how students acquire print literacy, particularly reading and writing, but also how listening–speaking vocabularies are developed. PWIM incorporates the inductive thinking and concept attainment models as students study words, sentences, and paragraphs. The model is the core of some very effective curricula where kindergarten and primary students learned to read and older beginning readers and writers were engaged in "safety net" programs for upper elementary, middle school, and high school students (see Joyce, Calhoun, Jutras, & Newlove, 2006; and Joyce & Calhoun, 2010, 2012). ICT provides access to enormous reservoirs of pictures that can be used in PWIM and support for investigations initiated with the model.

Concept Attainment (Chapter Six)

Originally built around studies conducted by Bruner, Goodnow, and Austin (1967) and adapted and applied to education by Lighthall, Joyce, and others, concept attainment is a close relative of the inductive model. Whereas the inductive process calls on students to *form* concepts, concept analysis leads the students to *attain* concepts developed by others. The teacher develops a data set containing exemplars of a concept and items where the attributes of the concept are not present. The students then study pairs of contrasting items until they are clear about the concept. The model is an efficient method for presenting organized information from a wide range of topics to students at every stage of development and also enables students to become more effective at concept formation. A short and succinct demonstration is available online at www.modelsofteaching.org.

Synectics (Chapter Seven)

Developed first for use with "creativity groups" in industrial settings, synectics was adapted by William Gordon (1961) for use in elementary and secondary education. Synectics is designed to help people "break set" in problem-solving and writing activities and to gain new perspectives on topics from a wide range of fields. In the classroom it is introduced to students in a series of sessions until they can apply the procedures individually and in cooperative groups. Although designed as a direct stimulus to creative thought, synectics has the side effect of promoting collaborative work and study skills and a feeling of camaraderie among students. Some recent studies and development by Keyes (2006) and Glynn (1994) have pushed the model a welcome new distance.

Mnemonics (Chapter Eight)

Mnemonics are strategies for memorizing and assimilating information. Teachers can use mnemonics to guide their presentations of material (teaching in such a way that students can easily absorb the information), and they can teach devices that students can use to enhance their individual and

cooperative study of information and concepts. This model also has been tested over many curriculum areas and with students of many ages and characteristics. We include variations developed by Pressley, Levin, and Delaney (1982); Levin and Levin (1990); and popular applications by Lorayne and Lucas (1974) and Lucas (2001). Because memorization is sometimes confused with repetitious, rote learning of obscure or arcane terms and trivial information, people sometimes assume that mnemonics deal only with the lowest level of information. That is by no means true. Mnemonics can be used to help people master interesting concepts, and in addition, they can be a great deal of fun.

Advance Organizers (Chapter Nine)

During the last 50 years this model, formulated by David Ausubel (1963), has accumulated a good-sized body of research. The model is designed to provide students with a cognitive structure for comprehending material presented through lectures, readings, and other media. It has been employed with almost every conceivable content and with students of every age. It can be easily combined with other models—for example, when presentations are mixed with inductive activity.

Inquiry Training (Chapter Ten)

This model is a direct and fun way to train students to look for causal relationships among variables. See a demonstration with students from India through www.modelsofteaching.org.

The Social Family

When we work together, we generate a collective energy called *synergy.* The social models of teaching are constructed to take advantage of this phenomenon by building learning communities. Essentially, classroom management is a matter of developing cooperative relationships in the classroom. The development of positive school cultures is a process of developing integrative and productive ways of interacting and norms that support vigorous learning activity. Table 1.2 identifies the models and several of the developers of the social models.

Partners in Learning (Chapter Eleven)

There has been a great deal of development work on cooperative learning, and great progress has been made in developing strategies that help students work effectively together. The contributions of three teams—led respectively by Roger and David Johnson, Robert Slavin, and Shlomo Sharan—have been particularly notable, but the entire cooperative learning community has been active in exchanging information and techniques and in conducting and analyzing research (see, for example, Johnson and Johnson, 2009). The result is a

TABLE 1.2 Social Models

Model	Developer	Purpose
Partners in Learning	David Johnson Roger Johnson Elizabeth Cohen	Development of interdependent strategies of social interaction; understanding of self–other relationships and emotions
Structured social inquiry	Robert Slavin and colleagues	Academic inquiry and social and personal development; cooperative strategies for approaching academic study
Group investigation*	John Dewey Herbert Thelen Shlomo Sharan Rachel Hertz-Lazarowitz	Development of skills for participation in democratic process; simultaneously emphasizes social development, academic skills, and personal understanding
Social inquiry	Byron Massialas Benjamin Cox	Social problem solving through collective academic study and logical reasoning
Laboratory method	National Training Laboratory (many contributors)	Understanding of group dynamics, leadership, understanding of personal styles
Role playing*	Fannie Shaftel George Shaftel	Study of values and their role in social interaction; personal understanding of values and behavior
Jurisprudential inquiry	James Shaver Donald Oliver	Analysis of policy issues through a jurisprudential framework; collection of data, analysis of value questions and positions, study of personal beliefs

*Indicates a model that has a full chapter or section in this text

large number of effective means of organizing students to work together. These range from teaching students to carry out simple learning tasks in pairs to complex models for organizing classes and even organizing whole schools into learning communities.

Cooperative learning procedures can facilitate learning across all curriculum areas, ages, and academic learning goals, as well as improve self-esteem, social skill, and solidarity.

Group Investigation (Chapter Twelve)

John Dewey (1916) was the major spokesperson for the idea—extended and refined by a great many teachers and shaped into a powerful definition by Herbert Thelen (1960)—that education in a democratic society should teach the democratic process directly. A substantial part of students' education should be through cooperative inquiry into important social and academic problems. The model also provides a social organization within which many other models can be used when appropriate. Group investigation has been used in all subject areas, with children of all ages, and even as the core social model for entire schools (Chamberlin & Chamberlin, 1943; Joyce, Calhoun, & Hopkins, 1999). The model is designed to lead students to define problems, explore various perspectives on the problems, and study together to master information, ideas, and skills—simultaneously developing their social competence. The teacher or facilitator organizes the group process and disciplines it, helps the students find and organize information, and ensures that there is a vigorous level of activity and discourse. Sharan and his colleagues (1988) and Joyce and Calhoun (1998) have extended the model and combined it with recent findings on the development of inquiring groups.

Role Playing (Chapter Thirteen)

Role playing is included next because it leads students to understand social behavior, their role in social interactions, and ways of solving problems more effectively. Designed by Fannie and George Shaftel (1982) specifically to help students study their social values and reflect on them, role playing also helps students collect and organize information about social issues, develop empathy with others, and attempt to improve their social skills. In addition, the model asks students to "act out" conflicts, learn to take the roles of others, and observe social behavior. With appropriate adaptation, role playing can be used with students of all ages.

The Personal Family

Ultimately, human reality resides in our individual consciousnesses. We develop unique personalities and see the world from perspectives that are the products of our experiences and positions. Common understandings are a product of the negotiation of individuals who must live and work and create families together.

The personal models of learning begin from the perspective of the selfhood of the individual. They attempt to shape education so that we come to understand ourselves better, take responsibility for our education, and learn to reach beyond our current development to become stronger, more sensitive, and more creative in our search for high-quality lives.

The cluster of personal models pays great attention to the individual perspective and seeks to encourage productive independence, so that people

become increasingly self-aware and responsible for their own destinies. Table 1.3 displays some of these models and their developers.

Nondirective Teaching (Chapter Fourteen)

Psychologist and counselor Carl Rogers (1961, 1982) was for three decades the acknowledged spokesperson for models in which the teacher plays the role of counselor. Developed from counseling theory, the model emphasizes a partnership between students and teacher. The teacher endeavors to help the students understand how to play major roles in directing their own educations—for example, by behaving in such a way as to clarify goals and participate in developing avenues for reaching those goals. The teacher provides information about how much progress is being made and helps the students solve problems, but it is the student who has to take initiative—the teacher scaffolds the student's investigation. The nondirective teacher has to actively build the partnerships required and provide the help needed as the students try to work out their problems.

The model is used in several ways. First, at the most general (and least common) level, it is used as the basic model for the operation of entire educational programs (Neill, 1960). Second, it is used in combination with other

TABLE 1.3 Personal Models

Model	Developer	Purpose
Nondirective teaching*	Carl Rogers	Building capacity for personal development, self-understanding, autonomy, and self-esteem
Positive self-concepts*	Abraham Maslow	Development of personal understanding and capacity for development
Awareness training	Fritz Perls	Increasing self-understanding, self-esteem, and capacity for exploration; development of interpersonal sensitivity and empathy
Classroom meeting	William Glasser	Development of self-understanding and responsibility to self and others
Conceptual systems	David Hunt	Increasing personal complexity and flexibility in processing information and interacting with others

*Indicates a model that has a full chapter or section in this text

models to ensure that contact is made with the students. In this role, it moderates the educational environment. Third, it is used when students are planning independent and cooperative study projects. Fourth, it is used periodically when counseling students, finding out what they are thinking and feeling, and helping them understand what they are about. Although designed to promote self-understanding and independence, it has fared well as a contributor to a wide range of academic objectives. Cornelius-White's (2007) review of many years of research on learner-centered teacher–student relationships—119 studies involving more than 300,000 students—examined the impact on cognitive, affective, and behavioral outcomes and reported positive effects and, importantly, that for applications where academic content was included, gains in content were correlated with gains in affect, including self-concepts.

Developing Positive Self-Concepts (Chapter Fifteen)

One of the most difficult tasks in teaching is helping students whose confidence has sunk to a level where they wallow helplessly in failure. They approach the ordinary tasks of the curriculum with dread and avoid those tasks when they can. Here we present a multidimensional approach that attempts to confront grade 4 to 12 students with the very thing they fear—learning to read—and bring those students into the world of success. The influential work of Abraham Maslow has been used to guide programs to build self-esteem and self-actualizing capability for 50 years. We explore the principles that can guide our actions as we work with our students to ensure that their personal image functions as well as possible.

Adaptations to the study of teachers as they expand their repertoire of teaching models have provided a means by which teachers can study their learning styles and processes (Joyce & Showers, 2002). The personal, social, and academic goals of education are compatible with one another. The personal family of teaching models provides the essential part of the teaching repertoire that directly addresses the students' needs for self-esteem and self-understanding and how to build support and respect among students.

The Behavioral Systems Family

A common theoretical base—most commonly called *social learning theory,* but also known as *behavior modification, behavior therapy,* and *cybernetics*—guides the design of the models in this family. The stance taken is that human beings are self-correcting communication systems that modify behavior in response to information about how successfully tasks are navigated. For example, imagine a human being who is climbing (the task) an unfamiliar staircase in the dark. The first few steps are tentative as the foot reaches for the treads. If the stride is too high, feedback is received as the foot encounters air

and has to descend to make contact with the surface. If a step is too low, feedback results as the foot hits the riser. Gradually, behavior is adjusted in accordance with the feedback until progress up the stairs is relatively comfortable.

Capitalizing on knowledge about how people respond to tasks and feedback, psychologists (see especially Skinner, 1953) have learned how to organize task and feedback structures to make it easy for human beings' self-correcting capability to function. The result includes programs for reducing phobias, learning to read and compute, developing social and athletic skills, replacing anxiety with relaxation, and learning the complexes of intellectual, social, and physical skills necessary to pilot an airplane or a space shuttle. Because these models concentrate on observable behavior and clearly defined tasks and methods for communicating progress to the student, this family of teaching models has a firm research foundation. Behavioral techniques are appropriate for learners of all ages and for an impressive range of educational goals. Table 1.4 displays the models and their developers.

Explicit Instruction (Chapter Sixteen)

Although reading without comprehension is not really reading, the explicit teaching of comprehension strategies has not been common in U.S. schools. However, research and development, practice, and results have given us a serviceable model. *Every* teacher will find this model useful.

Mastery Learning (Chapter Seventeen)

The most common application of behavioral systems theory for academic goals takes the form of what is called *mastery learning* (Bloom, 1971). First, material to be learned is divided into units ranging from the simple to the complex. The material is presented to the students, generally working as individuals, through appropriate media (readings, tapes, activities). Piece by piece, the students work their way successively through the units of materials, after each of which they take a test designed to help them find out what they have learned. If they have not mastered any given unit, they can repeat it or an equivalent version until they have mastered the material.

Instructional systems based on this model have been used to provide instruction to students of all ages in areas ranging from the basic skills to highly complex material in the academic disciplines. With appropriate adaptation, they have also been used with gifted and talented students, students with emotional problems, and athletes and astronauts.

Direct Instruction (Chapter Eighteen)

From studies of the differences between more and less effective teachers and from social learning theory, a paradigm for instructing directly has been assembled. Direct statements of objectives, sets of activities clearly related to the objectives, careful monitoring of progress, feedback about achievement, and tactics for achieving more effectively are linked with sets of guidelines for

TABLE 1.4 Behavioral Models

Model	Developer	Purpose
Social learning	Albert Bandura Carl Thoresen Wes Becker	The management of behavior: learning new patterns of behavior, reducing phobic and other dysfunctional patterns, learning self-control
Explicit instruction*	P. David Pearson & Margaret Gallagher Ruth Garner Gerald Duffy Laura Roehler and others	Learning to be a strategic reader
Mastery learning*	Benjamin Bloom James Block	Mastery of academic skills and content of all types
Programmed learning	B. F. Skinner	Mastery of skills, concepts, factual information
Direct instruction*	Thomas Good Jere Brophy Wes Becker Siegfried Englemann Carl Bereiter	Mastery of academic content and skills in a wide range of areas of study
Simulation	Many developers Carl Smith and Mary Foltz Smith provided guidance through 1960s when design had matured	Mastery of complex skills and concepts in a wide range of areas of study
Anxiety reduction	David Rinn Joseph Wolpe John Masters	Control over aversive reactions; applications in treatment and self-treatment of avoidance and dysfunctional patterns of response

*Indicates a model that has a full chapter or section in this text

facilitating learning. Two approaches to training have been developed from the cybernetic group of behavior theorists. One is a theory-to-practice model and the other is simulation. The former mixes information about a skill with demonstrations, practice, feedback, and coaching until the skill is mastered. For example, if an arithmetic skill is the objective, it is explained and demonstrated,

practice is given with corrective feedback, and the student is asked to apply it with coaching from peers or the instructor. This variation is commonly used for athletic training.

Simulations are constructed from descriptions of real-life situations. A less-than-real-life environment is created for the instructional situation. Sometimes the renditions are elaborate (for example, flight and spaceflight simulators or simulations of international relations). The student engages in activity to achieve the goal of the simulation (to get the aircraft off the ground, perhaps, or to redevelop an urban area) and has to deal with realistic factors until the goal is mastered.

In sum

The models briefly introduced here have been selected from many other possibilities. We are sure these can be used in classrooms and in cyberspace; their effectiveness has been substantiated by experience and formal research. As we will see later, achieving mastery over them takes practice. Teams of teachers working together to master a model can share reflections and companionship as one progresses from being a novice to achieving executive control over that model.

CHAPTER TWO

Building the Community of Expert Learners

Taking Advantage of Our Students' Capacity to Learn (and Ours)

A school teaches in three ways: by what it teaches, by how it teaches, and by the kind of place it is.

—Lawrence Downey (1967)

In a perfect world, we would come to adulthood knowing we had full-blown wisdom about how to raise children and how to teach them from infancy to adulthood. At least we'd be aware that those knowledges and attendant skills were latent, lying just below the surface and ready to come to life when we had babies or accepted jobs as teachers. In our imperfect world, we are not so lucky; most of us have to learn a lot about how to parent and how to teach. But we are not without equipment, because what we need *does* lie within us if we will allow it to find its way into our consciousness. Models of teaching and learning are designed to make that awakening a stimulating and positive adventure. Information and communication technologies (ICT) are going to help, particularly by bringing information and ideas closer to us and our children and learners all over the globe.

What People Bring to Life: Natural Learning Capability, Curiosity, and Creativity

From birth, we are programmed to reach out to living and nonliving things. Think how we loved our pillow, our blanket, or some stuffed toy. We not only loved them, we imbued them with a love that they returned to us. In the most desolate circumstances, a baby will treasure a stick or a stone if that's all there is at hand. Those of us who have pets learn how much they are an opportunity to extend our capacity for love and companionship. The other day Bruce

interrupted a telephone conversation to say something to our cat. The woman on the other end said, "Don't worry. I talk to my dog all the time."

Knowing how to love and care for things beyond ourselves is a great tool with which to begin our lives. We *know* that we and other creatures need affection and attention, and we know something about how to provide these to others even as we work our way through the egocentricity we were also born with. But we were not born with meanness or cruelty. Those have to be learned in a perverse environment.

People are also natural scientists. We investigate routinely at birth, looking at and touching things and manipulating them to see what happens. We just can't help it, for we want to know how our world works. We are a handful at that point, and those who care for us have to scoop us up at times just before we are about to connect ourselves to the electrical system or the oven. But we continue studying our world, crawling around and poking things to find out what happens.

Children don't just collect information; they also organize it. We're inborn scholars in the sense that we naturally build concepts and generalizations. We're born with an innate ability to discriminate things and organize all sorts of stuff into categories. As infants, we sorted things as hard or soft, comfortable or uncomfortable, rough or smooth, noisy or quiet. We learned to tell Mom from Dad, the cat from either, the cat from furry toys. We learned words. *There's* a big one—as we listened to the world around us, we sorted words, rapidly gaining control and making choices as we shouted *Da* to access Dad, *Baa* for our bottle, and *Ju* for our juice. We *want* to learn language—to listen and speak fluently. Deaf children are exultant when they discover that sign language exists. And there is no more thrilling moment to watch than when an improvement in hearing aids lets the world of sound into their minds and hearts.

Early language acquisition is easy because we're natural linguists. Once we have about 50 words we begin to make sentences, at first just two or three words long. As our minds seek to make sense of our world, we figure out which words are used for what. Wherever we find ourselves, we listen and learn to speak. In Greece, we learn Greek; in Thailand, we learn Thai; in Argentina, we learn Spanish. In Switzerland, we may learn French, German, and Italian, all at once. By the time we're 4 or so, we know the structure of our language and can understand and speak several thousand words—a basic storehouse that we will hear and process all our lives.

Scholars who study language development are continually amazed as they study young children's language development. Infants progress rapidly from when they utter a first word; by age 2, the average speaking vocabulary is 500 to 600 words. By age 5, the speaking vocabulary averages about 5000 words. By then children are also using the basic structures of language (such as syntax), and phonemic and phonological awareness is established for many.

There is considerable variance—a range of 2500 to 7500 words is common in populations that have been studied (Biemiller, 2010).

We are beginning to understand more about why homes and preschools have large effects. A major factor appears to be the amount of talk in the home and the nursery and preschool (Barnett, 2001; Dickinson, McCabe, & Essex, 2006; Hart & Risley, 1995). If the environment is language dense and rich, the natural linguist takes over and the child learns more words and more about the structure of the language in his or her environment. By surrounding the students with language, expertly taught preschools and kindergartens can level the field considerably. But, by age 5, children from the most linguistically poor families can learn to read if the appropriate models of teaching are used. The early years (K–2) curricula need to increase listening and speaking as well as reading and writing vocabulary. Overall vocabulary measured in grade 2 predicts 30 percent of the variance in reading comprehension in grade 11 (see Cunningham, 2009; Graves, 2006).

Just as learning language is a natural capacity, people are born anthropologists. We learn the norms of our culture rapidly by watching the people around us and imitating them. We'll eat literally anything, if our people do, and we'll stay away from any food our social environment shuns. Most of us mimic, then follow, the customs of our immediate world. If the people around us shake hands on greeting, we shake hands; if they hug, we hug; if they bow, we bow. In China, we'll learn Chinese customs. In England, we'll soon look and talk like miniature English people.

What can we—the parent, relative, neighbor, the teacher candidate, the formal educator, the experienced schoolteacher—do to strengthen, nurture, and channel these wondrous human capabilities? What is our role? Our work? *The first principle is learning to work with nature and avoid working against it.* If we learn to build classroom and school environments that capitalize on the way we are—the way *people* are—the natural learning ability of children will make us great teachers and parents. One of the inherent premises of inductive and other effective models of teaching is that we do not have to feed our knowledge of language, science, social studies, and mathematics to our students. Rather, we help them enhance their ability to learn. If we build learning communities that draw the students into inquiry into subject matter and help those students engage with it conceptually, they will master any subject. And, they will be learning more than our specified curriculum objectives: they will *learn how to learn* ever more powerfully, because they are practicing their thinking, because they have more information, because they are using this information, and because learning and understanding are satisfying. (See the introduction to the new science and English language arts standards for an elaborate affirmation of this position: National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010; National Research Council, 2012.)

Let's turn to the process of building those learning communities—the nurturant and stimulating environments that enable the capacities of our students to flourish as they educate themselves.

Creating Communities of Expert Learners

This book could have been called Models of Learning.

—Emily Calhoun to Bruce Joyce, maybe a hundred times

Let's begin by visiting two first-grade and two tenth-grade classrooms at 9:00 on the first day of school. All of the teachers are using teaching/learning models. The first part of each scenario describes the teaching/learning processes on the campus; that is, they each take place in a classroom in a school. Then we add connections to resources on the web and ways of obtaining and managing information, and they each become a *hybrid*—the campus and the web are working together.

Scenario

THE FIRST HOUR OF SCHOOL IN GRADE 1

The first-grade children are gathered around a table on which a candle and jar have been placed. The teacher, Jackie Wiseman, lights the candle and, after it has burned brightly for a minute or two, carefully covers it with the jar. The candle grows dim, flickers, and goes out. Then she produces another candle and a larger jar, and the exercise is repeated. The candle goes out, but more slowly. Jackie produces two more candles and jars of different sizes and repeats the process. Again the flames slowly go out.

"Now we're going to develop some ideas about what has just happened," she says. "I want you to ask me questions about those candles and jars and what you just observed." The students begin. She gently helps them rephrase their questions or plan experiments. When one asks, "Would the candles burn longer with an even bigger jar?" Jackie responds, "How might we find out?" Periodically, she will ask them to dictate to her what they know and questions they have and writes what they say on newsprint paper. Their own words will be the content of their first study of reading.

Jackie tells the children that she has planned another demonstration to provide them with more information. Using the interactive whiteboard as the monitor, she takes them to a website called The Naked Scientists (www.thenakedscientists.com) and, within that site, to the Kitchen Science page and then to an item called Losing Air.

She reads students the instructions about the demonstration, beginning with needed materials, which she shows and discusses as she readies the experiment.

The materials are

- A transparent Pyrex dish
- A candle designed to float
- A quart-sized wide-mouthed jar without a top
- Three coasters heavy enough to sink in water

Then Jackie pours water into the dish to a level of about 1½ inches, puts the coasters on the bottom of the dish, places the candle on the water, and lights it. After ensuring that it is burning well, she lowers the jar over it until it is resting on the edges of the coasters. In Figure 2.1 you can see the arrangement as if you were looking at it with your eyes level with the top of the dish.

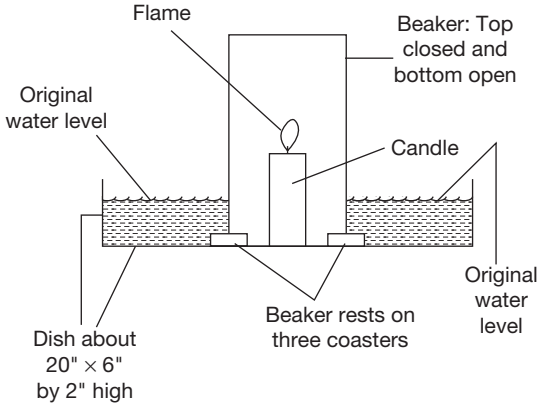
What happens? First, air bubbles escape from the jar, rising through the water. Then, the candle goes out and the water rises in the jar.

Jackie asks the students to describe the materials, their arrangement, and what happened after the candle was lit. She writes their answers on the whiteboard and takes care that the materials are identified and the events are described in order. They read the descriptions in unison after Jackie reads each one.

Then, she asks them to try to provide explanations of what happened: the onset of the bubbles and then the water rising in the jar.

Jackie is beginning her year with the model of teaching we call *inquiry training* (see Chapter 10) and is transitioning to the model we refer to as *scientific inquiry.*

FIGURE 2.1 Demonstration using candles on water



The model begins by having the students encounter what will be, to them, a puzzling situation. Then, by asking questions and conducting other investigations, such as trying larger and smaller jars, they build ideas and test them.

The inquiry leads them to the school library, where the librarian, Cathy Rodelheimer, shows them *Being a Scientist,* by Natalie Lunis and Nancy White. *Being a Scientist* is a big book (approximately 14 × 20 inches), heavily illustrated with photographs, that Jackie can read to students. When she reads the book, she asks her students to describe what they see in the lavish photographs that accompany the text. She also notes on the interactive whiteboard some words they would like to learn to read, including "you," "yes," and "scientist." She spells them as she prints them on the board and asks the children to spell them by repeating after her.

After each page, she also asks the students to dictate a summary or provide an answer to a question posed in the text. She writes these on the board, reading aloud what she writes. For example, one picture discusses the concept of *measuring.* On the next page, the photo shows a girl mixing *ingredients* for a cake and using a beaker to measure flour. The text asks how the young woman can find out how much flour she needs (Lunis & White, 1999).

The inquiry leads to what we call the *great new global library*—the information and ideas indexed on the web. The computer that is connected to the whiteboard contains Encarta (Jackie has an old copy on CD) and Compton and Britannica encyclopedias (see http://kids.britannica.com) that, with her help, the students can consult as the inquiry proceeds. Most important, in this and other projects, Jackie is building a community where the students will work together as they learn to read and write and explore social studies, science, and mathematics.

How does the candle project fit with the spirit of the new core curriculum standards? The science standards suggest that students learn content in such a way that they experience and learn how knowledge is generated. The science core is also unified by continuous hands-on experience. All students, K–12, should conduct investigations in the sciences and participate in projects where the methods and concepts of the sciences are employed. The experiential learning provides the concrete ground for understanding more complex and abstract principles as they are encountered, as well as the application to aspects of life that are within reach. The investigative frame of reference is a lifelong outcome. The Common Core State Standards for English Language Arts & Literacy stress literacy in the sciences—note how Jackie mixes gathering information from books, the web, and hands-on experiences and how this is based on the evidence presented in Chapter 1.

The social studies are similar—learning how to build knowledge and ideas while studying the immediate social environment. (See *Social Education* and *Social Education for the Young Learner,* publications of the National Council for the Social Studies).