



Research Review

School Improvement

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Annotated Bibliography on Learning

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Introduction

In education, a theory is more than a set of ideas about how the world works. Theory becomes practice. The ideas become the actions of students and teachers, the relationships they develop – student to student, student to teacher, and teacher to teacher – and how people relate to a body of knowledge. The ideas become classroom and school cultures. The ideas become district and state policies, standards and assessments.

Usually based on a variety of natural phenomenon – such as information about how the brain works – as well as sets of beliefs, learning theories manifest as the experiences that young people and adults have every day in environments called schools. What people believe about learning affects how they engage in the lives of learners. What people believe about learning affects the roles or positions they take related to various bodies of knowledge (represented by standards and curriculum), instructional practices or pedagogy, and assessment.

Some educators and policy makers claim that no theory predominates in education today. This may be true, yet, whether or not educators can label the reasons for their decisions as “theory,” all educators operate on the basis of a set of beliefs about how people learn. Sometimes, these theories are based on how they, themselves, were taught. Sometimes, these theories are based on how they, themselves, learn. Sometimes, they are based on what they learned in their teacher preparation programs or through research and reading.

Both educators and policy makers need to understand a variety of theories of how people learn in order to make appropriate decisions. This bibliography provides general information about a variety of theories still in practice in today’s schools. Following each theory is a list of references – each annotated – that the reader can use to probe deeper into both the theory and the practices that result from it.

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At the end of the bibliography (p. 22) the author provides a list of descriptors of how people learn based on experiences at Eagle Rock School and Professional Development Center, Estes Park, Colorado. Eagle Rock enrolls at no cost young people from across the country who have disengaged from school (dropped out or been expelled, for example). Eagle Rock staff have discovered some aspects of learning that are very important in terms of re-engaging young people as learners, keeping them in school and graduating them to worthwhile postsecondary opportunities.

Behaviorism

Behaviorism is a theory that restricts learning to what can be observed rather than what was then (in the late 1800s and early 1900s) accepted: what people through therapy said about themselves and their learning. Behaviorists hold that a learner's observable behaviors in response to a stimulus or prompt indicate whether or not learning has taken place and exactly what was learned. B. F. Skinner and E. L. Thorndike were primary proponents of this theory about how people learn. Many of Skinner's books have been reprinted by the B. F. Skinner Foundation (www.bfskinner.org).

Hirsch, E. D., Jr. *Cultural Literacy: What Every American Needs To Know*. Boston: Houghton Mifflin Company, 1987.

When this book came out, nearly everyone who bought it turned to the Appendix, which contains "The List," in alphabetical order from abominable snowman to Zurich, to see how culturally literate they were. The book created quite a stir, with its implication that students should know these terms in order to be educated. For some, the list was reductionist; for others, it was monocultural. In terms of learning, it implied a S-R theoretical base, with the stimulus being the term and the response being its definition or description. Some schools tried a "one-a-day" application of Hirsch's ideas.

Phillips, D. C. & Soltis, J. F. *Perspectives on Learning*. New York: Teachers College Press, 1998.

A rich book in terms of historical and contemporary theories of learning. The vignettes and case studies are especially helpful. The focus is mostly on higher education in a liberal arts setting, but the book is very useful in teacher preparation and inservice education courses.

Skinner, B. F. *The Technology of Teaching*. Cambridge, MA: B. F. Skinner Foundation, 1968, 2003.

This book is one of several that follow Skinner's seminal work *The Behavior of Organisms* (1938), in which he defines operant behavior; rate as an indicator of learning; and variables that impact behavior as a function. In *The Technology of Teaching*, he applies his theory to classrooms in terms of learning, control and management.

Skinner, B. F. *Beyond Freedom and Dignity*. Cambridge, MA: B. F. Skinner Foundation, 1971, 2002.

This definitive book was written for the public and summarizes much of Skinner's thinking. Its chapters on the technology of behavior, freedom, dignity, punishment, alternatives to punishment, values, and the evolution and design of a culture make the point that we need to deal better with human behavior. He favors a radically behaviorist approach rather than what he calls "dependence on states of mind and feelings."

Thorndike, E. L. *Educational Psychology: Briefer Edition*. New York: Columbia University Press, 1913.

This three-part text was designed to make Thorndike's ideas accessible to students and laypersons. The first part deals with innate human tendencies that affect learning. The second focuses on the psychology of learning and how experience changes human beings. The third looks at individual differences in terms of learning rates, transfer and amount of learning. An advocate of stimulus-response theory, Thorndike is known as the "father" of modern testing.

Brain-based Learning

This theory of learning is related to the neurosciences, constructivism and Vygotsky's philosophy of the social construction of meaning (all categories that are elaborated on below). The brain's capabilities are amazing, but – according to brain-based theorists and practitioners – schools do not provide optimum learning experiences for the brain. For example, the brain can process many things at the same time, but schools organize subjects singularly and break learning into tiny segments. The brain is not just a cognitive processor; it is also an emotional processor – in fact, a “whole” experience processor – but schools pay attention mostly to the academic. The brain's natural work is to make meaning through experience, but schools do not always engage students in active, memory-making experiences.

Bruer, J. T. “In search of brain-based education,” *Phi Delta Kappan*, 80:9, 648-657, (May 1999).

This article is a compilation of theory and practice related to brain research and its application in education. The author describes the 1990s as “the Decade of the Brain” and discusses the history of the research and its application, covering such topics as right brain/left brain theory (which he debunks) and sensitive periods for brain growth (about which he is skeptical).

Caine, R. and Caine, G. *Making Connections: Teaching and the Human Brain*. Alexandria, VA: Association for Supervision and Curriculum Development, 1994.

Renate and Geoffrey Caine synthesize brain research in this book, focusing on how the brain makes connections between past knowledge and current experiences. They focus on how schools promote – or fail to promote – these connections. This book describes a set of 12 principles for brain-based learning such as “The mind/brain is a complex adaptive system” and “The search for meaning is innate.”

Caine, R. & Caine, G. *Education on the Edge of Possibility*. Alexandria, VA: Association for Supervision and Curriculum Development, 1997.

This book is a follow-up to the Caines' Making Connections book. It focuses on the results of implementing their brain-based principles in two schools. The processes of change in these two schools force teachers to question assumptions and change their mental models and teaching practices. This book, thus, explores the implementation of brain-based learning strategies, as well as how the brains of those implementing them changed.

Fogarty, R. *Brain-Compatible Classrooms*. Arlington, IL: SkyLight Training and Publishing, 1997.

This book presents four key principles related to teaching with the needs of the brain in mind: setting the climate for thinking, teaching the skills of thinking, structuring the interaction with thinking, and thinking about thinking. Although it synthesizes research about the brain from a variety of fields, it is written for classroom application.

Hart, L. *How the Brain Works: A New Understanding of Human Learning, Emotion and Thinking*. New York: Basic Books, 1975.

Leslie Hart was among the first authors to write about the brain from the perspective of education. He used “brain compatible” to refer to classrooms that work best for the human brain in terms of learning, understanding, remembering and transferring information. The basis for his book is in the neurosciences, especially the biology of learning. His thesis is that forcing the brain to function in environments that are not compatible results in low learning outcomes.

Hart, L. *Human Brain, Human Learning*. Kent, WA: Books for Educators, 1999.

Teaching without considering what the brain needs is like “designing a glove with no sense of what a hand looks like and does,” according to Hart. The brain – what he calls the organ of learning – flourishes in environments for learning, specifically classrooms that have studied what the brain needs. Unfortunately, few schools have launched studies of what the brain needs, and few teachers know much about the brain. Studying the brain is not enough; educators must “design brain-fitting, brain-compatible instructional settings and procedures.” Schools would become “exciting centers where there is constant encounter with the richness and variety of the real world” as opposed to a “dreary egg crate of classrooms.”

Jensen, E. *Teaching with the Brain in Mind*. Alexandria, VA: Association for Supervision and Curriculum Development, 1998.

Jensen defines brain-based education as “a multidisciplinary approach based on what we currently know about how our brain works.” In this book he focuses on translating brain research into language for educators, parents and “laypersons” and identifying the corresponding factors he calls “applied educational neuroscience.” He has actively interacted with neuroscientists in his work.

Kovalik, S. J. & Olsen, K. D. *Exceeding Expectations: A User's Guide To Implementing Brain Research in the Classroom*. Covington, WA: Books for Educators, Inc., 2005.

On the basis of brain research, Kovalik developed Integrated Thematic Instruction (ITI). Essentially a conceptual curriculum model, it is grounded in the biology of learning. This book introduces ITI and helps readers implement the strategy in schools. One thematic focus of ITI is on the development of responsible citizens.

Sousa, D. A. *How the Brain Learns: A Classroom Teacher's Guide*. Reston, VA: National Association of Secondary School Principals, 1995.

In this book, Sousa reviews research and practice related to brain-based learning. He provides some cautions for the reader and then discusses basic facts related to the brain and its development. He presents information on how the brain processes information (memory, retention, transfer, thinking skills and learning) and addresses the importance of the arts for brain development.

Sylwester, R. *A Celebration of Neurons: An Educator's Guide to the Human Brain*. Alexandria, VA: Association of Supervision and Curriculum Development, 1995.

Sylwester, originally a biologist, has synthesized brain research in terms of application to education in this book. Once a teacher in a one-room school, Sylwester rejected behavior modification (behaviorism) and delved into the cognitive sciences to explain learning. He discusses how the brain is organized to learn, how adolescents' brains work, how a collaborative classroom assists brains in learning and other topics.

Sylwester, R. *How To Explain a Brain: An Educator's Handbook of Brain Terms and Cognitive Processes*. California: Corwin Press, 2005.

Designed for the nonscientist, this book defines and describes an “alphabet soup” of neural terms (such as “amygdala”). These terms and their definitions and descriptions are helpful to readers, but more relevant to educators is his description of how the brain works and learns as well as his ideas about the educational significance of brain functions and processes.

Wolfe, P. *Brain Matters: Translating Research into Classroom Practice*. Alexandria, VA: Association for Supervision and Curriculum Development, 2001.

Written for educators, this book presents a “mini-textbook on brain anatomy and physiology” and then discusses “how the brain encodes, manipulates and stores information.” The third part of the book gives some examples of “brain-compatible strategies.”

Constructivism

Constructivism is a theory of learning that says humans are predisposed (even compelled) to make meaning from experiences, drawing on past and integrating present experiences. People naturally construct mental models for their understanding (schema) and alter them as they integrate new experiences. Constructivism as a theory has important implications for teaching and learning. For example, learning is active not passive. It is self-regulated, situated in real settings and social. This theory of learning draws from work in the neurosciences, as well as brain-based learning, and the work of Dewey, Piaget and Vygotsky (see categories below).

Airasian, P. W., & Walsh, M. E. “Constructivist cautions,” *Phi Delta Kappan*, 78, 324-326, February 1997.

Airasian and Walsh discriminate between the theory and its implications for teaching. Although excited about constructivism in the classroom, they warn that moving toward application of a constructivist theory may be more challenging than it sounds. The authors explore why

constructivism appeals to so many educators but caution that students and teachers both have to learn how to work according to a constructivist approach and that the approach takes more time for learning once it's understood. They also caution that constructivism is not "anything goes" and that striving for right answers is still needed in schools.

Bereiter, C. "Constructivism, socioculturalism, and Popper's World 3," *Educational Researcher*, 23:7, 21-23, October 1994.

Bereiter addresses the theory of constructivism, especially according to the mental activities and social milieu of the learner. He asks where the mind is and where knowledge is. For some, mind is within and knowledge is outside. Popper – Sir Karl Popper (1972) – gave immaterial knowledge a location called World 3, World 2 being in the head and World 1 the physical world. Education functions mostly in World 2, what is in the head. Concepts, theories and knowledge are like things to us, something to be acquired. Constructivism lets students work in World 3, the meaning they have created for themselves by connecting Worlds 1 and 2.

Blais, D. M. "Constructivism – A theoretical revolution for algebra," *Mathematics Teacher*, 81:8, 624-31, 1998.

The author addresses the application of constructivism in mathematics, resulting in a process that changes novices to experts. Explanations, he claims, do not help that process. Instead, novices need to experience mathematics – as processes, as ways of thinking. He asserts, "Constructivism is not a wimpy, say-nothing, your-ideas-are-fine theory." However, "Knowledge is something that learners must construct for and by themselves. There is no alternative. Discovery, reinvention, or active reconstruction is necessary." Conventional explaining in math classes leads to "the habit of dependence and a belief in one's own helplessness [that] ensures that the novice will remain just that."

Brooks, J. G. and Brooks, M. G. *The Case for Constructivist Classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development, 1993.

This book does a superb job of uniting the theory of constructivism with classroom practice. The authors (one from a university, the other a district) provide a clear description of the theory and five principles related to the theory. Then, they provide detailed and specific descriptions of teaching practices that follow upon the principles and contrast constructivist-based and traditional, direct-teaching classrooms.

Brooks, J. G. *Schooling for Life: Reclaiming the Essence of Learning*. Alexandria, VA: Association for Supervision and Curriculum Development, 2002.

This book is a follow-up to the Brooks' 1993 book. It focuses on how students experience schools – as places to put in their time, different from their "real lives." When schools are run to raise test scores, rather than ensure understanding, they become meaningless to students. Brooks issues a call to make schools the center of intellectual, ethical and aesthetic growth, and provides classroom examples that "honor the complexity of learning."

Bruner, J. *Toward a Theory of Instruction*. Cambridge, MA: Harvard University Press, 1966.

This book, a classic that led to MACOS (Man: A Course of Study) in the 1960s, is a radical departure from traditional curriculum. Bruner is somewhat critical of the "cognitive revolution," arguing that learning needs to take into account both social and historical perspectives of the learner, as well as how the brain works. He advocates recognizing that education must be based on culture, not just mind.

Eisner, E. *Cognition and Curriculum – A Basis for Deciding What To Teach*. New York: Longman, 1982.

In this proposal for a new curriculum, Eisner emphasizes that school is "unreal," that is, the problems that students encounter in school are very different from real-life problems. School problems are well-constructed and uncomplicated, and their solutions are unambiguous – unlike life. He argues the thinking students do in school is black and white, true and false, yes or no, correct or incorrect. Educators need to prepare students for real life through curriculum that helps students develop imagination and a creative intellect. Eisner is an advocate of the arts in education as one way to help learners learn to think.

Hyerle, D. *Visual Tools for Constructing Knowledge*. Alexandria, VA: Association for Supervision and Curriculum Development, 1996.

Most construction of knowledge is done verbally (writing, responding to a reading, etc.). Hyerle makes the case that visual tools such as drawing, clustering, Venn diagrams, schematics, etc., help everyone (not just the “verbally reluctant”) construct meaning. Hyerle maintains that visual tools provide a direct route to showing meaning in a nonlinear fashion (which corresponds to deep meaning, not just memorization). This book presents both the theory behind the tools and the tools themselves.

Newman, D., Griffin, P., & Cole, M. *The Construction Zone: Working for Cognitive Change in School*. Cambridge: Cambridge University Press, 1989.

This book provides a deep discussion about the basic concepts related to cognitive change. In addition to theory, however, it describes how meaningful tasks or experiences can be built into curriculum units and how goals can be met (even in a constructivist environment in which everyone is constructing meaning individually). In fact, this book provides a good description of how social mediation helps individuals achieve common goals. The book also resolves the apparent mismatch of a constructivist-based classroom with traditional assessment practices.

Prawat, R. S. “Teachers’ beliefs about teaching and learning: A constructivist perspective,” *American Journal of Education*, 100, 354-95, 1992.

Prawat explores the importance of understanding what teachers believe about the nature of knowledge and how people learn. These beliefs, or epistemologies, impact their curriculum implementation and instructional approaches. Teachers’ epistemologies affect their use of teaching strategies, their adaptation of curriculum, their use of resources, their interest in student opinions and their interest in changing all these to better serve learners. Prawat contends that teachers need to experience professional development from a constructivist point of view – through experience, collaboration and discussion – in order to become more constructivist oriented themselves

Smagorinsky, P. “If meaning is constructed, what is it made from? Toward a cultural theory of reading,” *Review of Educational Research*, 71:1, 133-169, Spring 2001.

In this article, Smagorinsky examines meaning, particularly as it affects reading. Using the ideas of Vygotsky (social construction of meaning), Smagorinsky describes reading as a transaction that is culturally mediated. The reader creates his or her own “text” on the basis of the text being read. The new “text” is related to the culture of the reader. The author provides examples and concludes that meaning is neither in the reader nor in the text but in the transaction zone linking the two.

Southwest Educational Laboratories (SEDL). *Classroom Compass: Constructing Knowledge in the Classroom*, 1:3, Winter 1994.

In this issue of *Classroom Compass* produced by SEDL, the focus is on constructivism, beginning with a discussion of how people learn. Then, in very readable text, the authors describe what a constructivist teacher (a teacher acting according to the theory of constructivism) does, including “setting up problems and monitoring student exploration, guiding the direction of student inquiry and promoting new patterns of thinking.” The article provides some advice for “easing into constructivism” and lists descriptors of a constructivist-based classroom.

Zahorik, J. A. *Constructivist Teaching*. Bloomington, IN: Phi Delta Kappa Educational Foundation, 1995.

This Phi Delta Kappa “Fastback” (a pamphlet-style book) presents a history of the constructivist movement and an explanation of the theory according to a philosophy of knowledge and an understanding of how humans learn. It describes five basic elements and four types of teaching practice based on the theory and how a classroom becomes more constructivist in its approach. It ends with some cautions. A quick read.

Control Theory

William Glasser is the originator of control theory. He refutes behaviorism, claiming that what (and how) students learn is entirely a factor of intrinsic motivation (rather than external stimulus and response; i.e., teachers cannot make students learn). Students learn according to what they need at any particular time. Intrinsic motivation is achieved when learners want their needs met in the areas of love, power, freedom, survival, etc. Glasser describes “boss teachers” who use rewards and punishments (a behaviorist approach) and “lead teachers” who understand how students are motivated to control their behavior so they receive satisfaction.

Glasser, W. *Control Theory*. New York: Perennial Library, 1986.

This book is the first to introduce “control theory,” based on Glasser’s observation that students who are quite capable of learning sometimes make no effort to do so. Glasser describes “control theory” as an understanding that intrinsic motivation is the only way that students learn and that, therefore, teachers should rid themselves of the false premise they can make students learn. Who’s in control of the learning? Glasser would answer it is always the individual learner who chooses to learn based on need or desire. He advocates what is now called “self-directed learning.”

Glasser, W. *The Quality School*. New York: Harper & Row, 1990.

Building upon his ideas about control theory, Glasser described in this book non-coercive lead-managers who understand that student choices (based on their needs) are the key to their motivation and their learning. He coined the word “choice theory” to replace “control theory,” which had a negative connotation. He widened his work to talk about a quality world in which a quality education is possible because “quality work feels good.” He describes how one would create a quality school.

Glasser, W. & Dotson, K. L. *Choice Theory in the Classroom*. New York: Quill, 1998.

This book elaborates on what Glasser means by “choice theory,” focusing on how the theory translates into a “productive, classroom model of team learning with emphasis on satisfaction and excitement. Working in small teams, students find that knowledge contributes to power, friendship and fun” (from a review by Madeline Hunter, University of California Los Angeles). This book contributed to the movement toward cooperative learning.

Kohn, A. *Beyond Discipline: From Compliance to Community*. Alexandria, VA: Association for Supervision and Curriculum Development, 1996.

Echoing the same theory as Glasser, Kohn— sometimes called an iconoclast – makes the case that discipline – whether it is a carrot or a stick system – is an external system, and the many discipline programs available to teachers promising to get students to do what teachers want them to do lead to the wrong results. Complying with orders about how to act fails to help students develop their own social and moral resources. Kohn’s illuminates his point with vignettes from real classrooms, and his book is, overall, pragmatic and hopeful.

Kohn, A. *Punished by Rewards: The Trouble with Gold Stars, Incentive Plans, A’s, Praise, and Other Bribes*. Mariner Books, 1999.

In this book, Kohn discusses how external rewards (extrinsic motivational tools), including such apparently “benign” forms as praise or winning a competition, undermine school efforts to get students to learn. This book, aimed at a general audience, suggests that rewards are similarly detrimental in families and workplaces. Incentives and bribes do not lead to quality and achievement. This book explicitly addresses behaviorism as a reward system and explains why lasting behavior change has to come from within.

Kohn, A. *No Contest: The Case Against Competition*. New York: Houghton-Mifflin, 1986.

At Eagle Rock, which operates without grades, the emphasis is on everyone learning. There is no competition, and students help each other achieve. That’s the point that Kohn is trying to make in this book. He wants to replace competition (not only in academic areas) with collaboration.

He discusses how competition – an extrinsic motivator – makes children anxious and afraid to take risks in learning.

Kohn, A. *The Schools Our Children Deserve: Moving Beyond Traditional Classrooms and “Tougher Standards.”* Mariner Books, 2000.

Kohn argues in this book that John Dewey has been replaced with the king of test-tutoring, Stanley Kaplan. He suggests that schools today require students to learn facts à la E. D. Hirsch, rather than concepts and ideas that have application to real life. He refers to research as well as to classroom practice. He charges that curriculum is mind-numbing, simplistic and responded to passively by students who deserve much more. He admonishes educators and policymakers to change their focus from winning (high test scores) to helping young people learn in depth and at higher levels, what cannot readily be tested through typical tests.

Kohn, A. *What Does It Mean To Be Well Educated? And Other Essays on Standards, Grading and Other Follies.* Boston: Beacon Press, 2004.

Kohn continues his criticism of current trends in education, this time focusing on grades and test scores (all of which can be seen as extrinsic motivators). He describes what should be the real goals of education rather than the models of education currently in force in a test-driven society. He also makes the point that test scores and grades are counterproductive motivational strategies. One essay is particularly critical of the corporate world that profits from tests and test preparation, textbooks aligned to tests, etc. He addresses larger social concerns such as the need for preparation for a democratic society.

Dewey

Most of the writers and thinkers whose works are described in this bibliography make reference to the writing and thinking of John Dewey. Here are a few of his most influential books.

Dewey, J. *The School and Society and the Child and the Curriculum.* Chicago: Centennial Publications of The University of Chicago Press, 1991.

This book (a collection of lectures) focuses on educational theory. Dewey reflects on past versions of his theories and how they were applied. He discusses the school and social progress, the life of the child, waste in education, the psychology of elementary education and other areas. He describes three years of the University of Chicago's elementary school. This edition has a new introduction by Philip W. Jackson.

Dewey, J. *Democracy and Education.* New York: Free Press, 1997.

In this landmark book (reprinted in 1997), Dewey describes education from a number of points of view: as a necessity of life; as a social function; as direction; as growth; as preparation, unfolding and formal discipline; as conservative and progressive; and as embodying the democratic conception. He lays out aims in education (such as natural development and social efficiency), and discusses interest and discipline, experience and thinking. He addresses practical concerns about curriculum to be taught, as well as theories of knowledge and theories of morals.

Dewey, J. *Experience and Education.* New York: Free Press, 1997.

This small book (96 pages) elaborates on Dewey's philosophy of progressive, experience-based education. As an advocate of progressive education in the 1930s, Dewey wrote that education should be relevant to real life and based on problem solving and experiences. Dewey aligns his feelings about education with the needs of a country that is a democracy. Neither autocracy nor didacticism fit these needs. Instead, the word “freedom” does. Experience and education are not the same thing, according to Dewey; indeed, experience must be evaluated, reflected upon, synthesized or otherwise processed to lead to education.

Dewey, J. *How We Think.* New York: Dover Publications, 1997.

Dewey describes how to “train” students to think well in this book. He describes logic, use of factual information, concrete and abstract thinking, activity, language, observation and other aspects of thinking and learning.

Dysfunctions in Learning

Some educators and researchers describe how people learn according to dysfunctions in learning, among them learning disabilities (LD), attention deficit disorder (ADD), attention deficit hyperactivity disorder (ADHD) and dyslexia. This bibliography does not attempt to address these disorders in terms of offering a window on how people learn or do not learn.

Instead, it presents the work of Mel Levine, M.D., a professor of pediatrics at the University of North Carolina Medical School and director of the university's Clinical Center for the Study of Development and Learning, who dismisses labels such as LD, ADD or ADHD, arguing that these simplify learning differences so much they are relatively unusable in terms of helping young people learn.

Levine also goes beyond learning styles and preferences to identify individual learning profiles. Levine maintains that everyone has a profile, made up of several different constructs and, within each construct, a number of different behaviors. He works with learners, their families and their teachers to identify learning patterns and makes the case that adults can maximize children's success by helping them strengthen some aspects of the learning profile and bypass or overcome others. He advocates "demystifying" learning patterns so students can take charge of their learning.

Levine, M. *Keeping a Head in School: A Student's Book About Learning Abilities and Learning Disorders*. Cambridge, MA: Educators Publishing Service, Inc., 1990.

This book was written for adolescents and pre-adolescents, although older and younger people can benefit from its clear statements and descriptions. It is especially useful for parents working with their children.

Levine, M. *Educational Care: A System for Understanding and Helping Children with Learning Problems at Home and in School*. Cambridge, MA: Educators Publishing Service, Inc., 1994.

This book was written for adults (teachers, parents, researchers, psychologists and psychiatrists, physicians, etc.). It discusses the following: phenomena related to weak attention controls, phenomena related to reduced remembering, phenomena related to chronic misunderstanding, phenomena related to deficient output, phenomena related to delayed skill acquisition and phenomena related to poor adaptation. It provides tools for assessment, management and demystification.

Levine, M. *A Mind at a Time: America's Top Learning Expert Shows How Every Child Can Succeed*. New York: Simon & Schuster, 2002.

This book was written for the general public. It explains the theory, discusses ways of learning and describes the following systems: attention control, memory, language, spatial and sequential ordering, motor skills, higher thinking and social thinking. It describes what happens when one of these systems is not functioning as well as it could and how a mind "can be realigned." Most importantly, it discusses how minds can grow and how education should support all kinds of minds.

Levine, M. *Ready or Not, Here Life Comes*. New York: Simon & Schuster, 2005.

In this book, Levine focuses on what happens when a student graduates from high school, unready for life. He advocates that schools focus on "life prep" which addresses the four I's: inner direction (self awareness), interpretation (understanding the outside world), instrumentation (acquiring mental tools) and interaction (ability to relate to others). He calls young people in their late teens and early twenties "start up" adults.

Also see "Connecting Minds," the newsletter from All Kinds of Minds; Schools Attuned, a program for schools that want to approach learning disorders with Levine and his staff; and the Web site www.allkindsofminds.org.

Experiential Learning

It is appropriate that this category should follow so closely the Dewey category. Rogers, Jung and Piaget were others who acknowledged the importance of experience in learning. The theory, simply put, is that people learn from experience. They learn by doing. Experiential education often features team learning, service learning, “whole-child” learning (that is, not just academics), outdoors/wilderness/adventure experiences (see Kurt Hahn’s work, for example), character education, active learning (real, simulations, role-playing), choice-making, integrated/interdisciplinary content, problem solving, internships, etc.

Joplin, L. “On defining experiential education,” *The Journal of Experiential Education*, 4(1), 17-20, 1981. Laura Joplin devised a Five Stage Model for experiential education: focus, action, support, feedback and debrief. Most experiential educators stress that experience is not enough; it must be followed with – at a minimum – reflection, both individual and social, in order for learning to take place.

Kolb, D. A. *Experiential Learning: Experience as the Source of Learning and Development*. New Jersey: Prentice Hall, 1984.

Kolb was first known for his learning styles model (1984), which postulated a four-stage learning cycle (concrete experience, reflective observation, abstract conceptualization and active experimentation). The model gave rise to experiential learning theory (ELT). This book addresses the question “What is learning?” from psychological, sociological and philosophical points of view. The book makes a case for lifelong and problem-based learning. Kolb is not an educator; rather, he’s a professor of organizational behavior at Case Western Reserve University.

Wigginton, E. *Sometimes a Shining Moment: The Foxfire Experience*. Garden City, NY: Anchor Press/Doubleday, 1985.

An example of an interdisciplinary, experiential curriculum is the Foxfire experience. It involved students in Rabun Gap, Georgia, in researching the history and culture of their environment and then publishing a book about their discoveries. Over the years, students in Rabun Gap published many Foxfire books, and students in other schools around the world published their own versions of the Foxfire books. This book describes the processes involved in researching, writing and publishing such books.

Expertise

In search of knowledge about how people learn, cognitive scientists and others have examined the differences between experts and novices in a variety of fields. They began by examining master and beginning chess players. Then they explored expertise in areas such as music, mathematics, science and history. In their quest to understand the learning that experts have that novices lack, researchers have identified higher-order thinking skills such as these that are critical for learning: chunking information, noticing patterns, deep content knowledge, having more than isolated facts, quick retrieval of information, flexibility in new situations, etc.

Bereiter, C. & Scardamalia, M. *Surpassing Ourselves: An Inquiry into the Nature and Implications of Expertise*. Peru, IL: Open Court Publishing Company, 1993.

A very readable book about expertise in human behavior, this book addresses expertise in terms of education, lifelong learning and apprenticeship. One of the main points the authors make is that expertise “requires enormous amounts of knowledge – far more than anyone, even the experts, had supposed.” We need experts, the authors maintain, and the good news is that “the capacity to acquire expertise is ... one of the great and peculiar strengths of the human species.” The authors analyze writers and how they come to be experts.

Chi, M. T. H., Glaser, R. & Farr, M. J. (Eds.). *The Nature of Expertise*. Hillsdale, NJ: Erlbaum, 1988. Mostly a collection of papers presented at a conference on thinking and learning, this book features chapters on how expertise is acquired and under what learning conditions. The various authors focus on practical skills, programming skills, medical diagnosis, cognitive psychology, artificial intelligence and ill-defined problems. They present representative work of experts as well as the different approaches used by experts in different areas.

Ericsson, K. A. & Smith, J. (Eds.). *Toward a General Theory of Expertise: Prospects and Limits*. Cambridge, England: Cambridge University Press, 1991.

Analyses of experts, such as chess masters, musicians, athletes, performers and writers, provided the authors information on the cognitive processes that yield outstanding performances. The authors maintain that expertise is largely an acquired skill based on focus over a long period of time on the demands of a particular area, rather than innate talent. Experts are generally faster in accessing a larger body of knowledge than novices.

Gardner, H., Csikszentmihalyi, M., & Damon, W. *Good Work: Where Excellence and Ethics Meet*. New York: Basic Books, 2001.

Howard Gardner (see Multiple Intelligences) teamed with Mihaly Csikszentmihalyi, professor at the Drucker School of Management at Claremont Graduate University in Claremont, California (who wrote, among other things, *Flow*), and William Damon, professor of education at Stanford University, to write about "good work" and The GoodWork Project®. This project – and the book about it – describes research (200 lengthy, in-depth interviews) into the work done by journalists and geneticists, the former "well-aligned," the latter "misaligned" because of contradictory pressures in the jobs. The project looks at how professionals can achieve good work even when stress is upon them.

Glaser, R. "On the nature of expertise," in Klix, F., & Hagendorf, H. (Eds.), *Human Memory and Cognitive Capabilities: Mechanisms and Performances*. Amsterdam, The Netherlands: Elsevier Science Publishers, 1986, 915-928.

Expertise arises from the connection between knowledge structures and processing abilities, according to Glaser. Experts can quickly consult an organized body of ideas and processes related to their particular field of expertise. Expert performance is characterized by rapid access to an organized body of both conceptual and procedural knowledge.

Glaser, R. "Thoughts on expertise," in Schooler, C., & Schaie, W. (Eds.), *Cognitive Functioning and Social Structure Over the Life Course*. Norwood, NJ: Ablex, 1987, 81-94.

Novices and experts behave differently. Cognitive psychologists, studying human performances, have learned that experts have acquired their skills over long periods of experience and learning, and their skill sets are very different from those of novices.

Glaser, R. "Expertise and learning: How do we think about instructional processes now that we have discovered knowledge structures?" in Klahr, D., & Kotovsky, K. (Eds.), *Complex Information Processing: The Impact of Herbert A. Simon*. Hillsdale, NJ: Erlbaum, 1989, 269-282.

Glaser comments on new instructional strategies that can lead to expertise. Based on examination of human performance from the point of view of cognitive analysis, Glaser describes these characteristics: Experts focus on rapid pattern recognition, the ability to represent those patterns and self-elaboration related to problems in order to discover tactics leading to solutions.

Glaser, R. 'Expert knowledge and processes of thinking,' in Halpern, D. F. (Ed.). *Enhancing Thinking Skills in the Sciences and Mathematics*. Hillsdale, NJ: Erlbaum, (1992).

Glaser presents six generalizations that can be made about an expert's knowledge: specificity of proficiency; perception of meaningful patterns; selective memory search; procedural and goal-oriented knowledge; self-regulatory processes; and routinized proficiency. He provides an example of expert writing that was accomplished through the writer's abilities to be specific, integrate knowledge, represent ideas, monitor the writing, keep a goal orientation, practice, self-monitor, work according to principles and construct meaning for social purposes.

Shulman, L. "Those who understand: Knowledge growth in teaching," *Educational Researcher*. 15:2, 4-14. 1986.

Lee Shulman addresses expertise in the role of teacher. He rephrases George Bernard Shaw's saying as "Those who can, do. Those who understand, teach." Involved in helping the medical field improve their own education programs, Shulman noticed that the work of physicians was being studied as "complex, autonomous, thoughtful, reflective" and teachers were being prepared in a "mindless" stimulus-response way (see Behaviorism). With others, Shulman initiated a research focus on teachers as experts. Shulman made "how teachers reason ... how teachers think about, understand, and reason with the main ideas, concepts and principles of the different subjects they teach" a focus of his work.

Shulman, L. "Knowledge and teaching: Foundations of the new reform," *Harvard Educational Review*, 57, 1-22, 1987.

Shulman posits that teacher education programs have "a body of knowledge" just like other fields. The job of teacher education programs is to move teachers from novice to expert in this body of knowledge, which consists of teacher scholarship related to content knowledge as well as how to teach that content. He is not content to describe the body of knowledge as teacher behaviors based on how students do on standardized tests but wants expertise to be developed in teachers so they produce thinking students.

Sternberg, R. J. & Grigorenko, E. L. *The Psychology of Abilities, Competencies and Expertise*. England: Cambridge University Press, 2003.

The editors focus on how the nature of abilities, competence and expertise are related. They can be seen as distinct, but the authors of chapters in this book see them as related and a part of a developmental process. Chapters end with some speculation on the implications of their premises for education, science and society.

Wineburg, S. *Historical Thinking and Other Unnatural Acts: Charting the Future of Teaching the Past*. Philadelphia: Temple University Press, 2001.

Wineburg provides a good example of the application of expertise in a content area, in this case, history. An educational psychologist, Wineburg addresses the expertise an historian must have and how students can become expert historians. This book is oriented toward teachers who want students to study history by becoming historians. In addition to the theory behind how historians become experts, Wineburg provides interesting (and sometimes unusual) quantitative and qualitative research activities. He presents the reasons for studying and history ("as a unique cognitive discipline, with areas worth cultivating") as well as challenges for students and teachers.

General Resources

Lambert, N. M., & McCombs, B. L. (Eds.) *How Students Learn: Reforming Schools Through Learner-Centered Education*. Washington, DC: American Psychological Association, 1998.

This book provided the research base for the American Psychological Association's principles for learner-centered education in these areas: metacognitive and cognitive factors, affective factors, developmental factors, personal and social factors, and individual differences. Lambert and McCombs make these points about learning: "When one examines the learner-centered principles, it is clear that the concept suggests more than that. The principles apply to all of us, cradle to grave, from students in the classroom to teachers, administrators, parents, and others influenced by the process of schooling. Other people equate learner-centered with the affective side of education – quality interpersonal relationships, climates of caring, and focus on fostering students' competence and sense of well-being. Again, we think that's only part of the picture. When one looks across the domains covered in the principles – the metacognitive and cognitive, affective, personal and social, developmental, and other individual differences factors – it is clear that there is an emphasis on both the learner and learning. The central understanding that emerges from an integrated and holistic look at the principles, however, is that for educational systems to serve the needs of every learner, it is essential that every instructional decision focus on the individual learner – with an understanding of the learning process (p. 9)."

Marzano, R. J. (*Dimensions of Thinking: A Framework for Curriculum and Instruction*. Alexandria, VA: Association for Supervision and Curriculum Development, 1988.

Marzano postulated five dimensions of thinking, developed a general framework, and then translated this framework in later books into classroom instructional guidelines, assessment guidelines (with Deborah Pickering and Jay McTighe) and a teaching framework. The five dimensions of thinking are metacognition, critical and creative thinking, thinking processes (which he defined as larger, multi-step uses of thinking skills), core thinking skills (such as classifying and summarizing), and connecting thinking to content knowledge.

Marzano, R. J., Pickering, D., & Pollock, J. E. *Classroom Instruction That Works: Research-based Strategies for Increasing Student Achievement*. Alexandria, VA: Association for Supervision and Curriculum Development, 2001.

Marzano and his colleagues translate what they have learned into very specific strategies that can be used to help students learn: Identifying similarities and differences; summarizing and note taking; reinforcing effort and providing recognition; homework and practice; nonlinguistic representations; cooperative learning; setting objectives and providing feedback; generating and testing hypotheses; and questions, cues and advance organizers. Classroom examples proliferate, and it becomes clear how powerful these strategies are.

Marzano, R. J. *What Works in Schools: Translating Research into Action*. Alexandria, VA: Association for Supervision and Curriculum Development, 2003.

Marzano describes a variety of factors that affect student learning, ranging from underestimating student potential to use of specific learning strategies. He recommends specific actions that educators can take to help students learn and challenges schools in the United States to ratchet up their effectiveness by actually using 35 years of research translated into practice.

National Research Council; Bransford, J., Brown, A., & Cocking, R. (Eds.) *How People Learn: Bridging Research and Practice*. National Academies Press, 1999. (Available online at <http://www.nap.edu/openbook/0309065577/html/index.html>)

This book follows upon the report below, *How People Learn: Brain, Mind, Experience and School*. It does as it says; it bridges the research reported in that book to practice (although, to be fair, the first book frequently describes practice, too). Only 78 pages long, this book is easy to read. Its chapters address the key findings of the first book in terms of implications for teaching, bringing order to chaos, designing classroom environments and applying the design framework to adult learning. This book also provides responses to the first book from the education and policy communities, and proposes a research and development agenda.

National Research Council; Bransford, J., Brown, A., & Cocking, R. (Eds.) *How People Learn: Brain, Mind, Experience and School*. Washington, DC: National Academy Press, 2000. (Available online at <http://www.nap.edu>).

This is a superb general book about learning, well worth reading for an overview. It was developed by the Committee on Developments in the Science of Learning, the Committee on Learning Research and Educational Practice, and the Commission on Behavioral and Social Sciences and Education within the National Research Academy. In a very readable way, this book elucidates the progress of learning “from speculation to science,” addresses learners and learning (“How experts differ from novices,” “Learning and transfer,” “How Children Learn,” and “Mind and Brain”), teachers and teaching (“The design of learning environments,” “Effective teaching: Examples in history, mathematics, and science,” “Teacher learning,” and “Technology to support learning.”) Finally, it offers suggestions for “Future directions for the science of learning.” This book has a corollary in *How People Learn: Bridging Research and Practice*.

Learning Communities

This concept about how people learn builds on the ideas of social constructivism (see Vygotsky and constructivism). Essentially, people – students as well as adults – learn better in a community oriented toward learning, communities in which learning is the main purpose for working together. Many educators and researchers have written about learning communities, but their ideas are mostly about adults in a school who form learning communities, not *students* in learning communities. The closest educators have come to describing a student-learning community or a student-and-faculty-learning community is the approach to instruction known as cooperative learning.

Dufour, R., & Eaker, R. *Professional Learning Communities at Work: Best Practices for Enhancing Student Achievement*. Bloomington, IN: National Educational Service, 1998.

Rick Dufour was superintendent in Lincolnshire, Illinois, and knew that, in order for students to succeed, he needed to create a professional learning community (PLC) among his teachers. He thought that if his teachers could work together they could improve student learning. PLCs have a shared mission, vision, values and goals (all focused on student learning); members of a PLC are not off “doing their own thing.” They engage in collective inquiry and are oriented toward action research and experimentation to help students learn. They expect continuous improvement amongst themselves and are results-oriented. DuFour provides great examples from his work at Adlai Stevenson High School.

DuFour, R., Eaker, R., & Karhanek, G. *Whatever It Takes: How Professional Learning Communities Respond When Kids Don't Learn*. Bloomington, IN: National Educational Service, 2004.

This book narrows the discussion of professional learning communities to a focus on students who don't learn. It suggests that schools need to make time for teachers to assist those students ... and provide support and strategies for working with them. It's not enough for individual teachers to care whether or not students learn; every student in a school is the responsibility of every teacher. Examples from four schools result in a “Pyramid of Interventions.”

Eaker, R., DuFour, R., & DuFour, R. *Getting Started: First Steps in Transforming Your School into a Professional Learning Community*. Bloomington, IN: National Education Service, 2002.

Robert Eaker, a university provost, Rick Dufour, a former superintendent and Rebecca DuFour, a former elementary school principal, teamed to write this “how-to” book. The book describes a process that functions along a continuum and is never “done.” The hard work of building a learning community makes a difference in the learning of students.

Kagan, S., & Spencer, D. *Cooperative Learning*. San Juan Capistrano, CA: Kagan Cooperative Learning, 1994.

Kagan and Spencer describe over 50 forms of cooperative learning, several that have research results to substantiate them. They recommend the choice of strategies be based on purpose and the students with whom the strategy is to be used. For example, STAD (student teams achievement division) provides for students to work together on something they've all seen or done. Once members of a group are all satisfied the work is done well, they call over a teacher who quizzes them individually and as a whole group to assess their level of learning. In Constructive Controversy, pairs in a four-member group take different sides on an issue and engage in mock debates first on one side and then on another.

Johnson, D. & Johnson, R. T. *Learning Together and Alone: Cooperative, Competitive and Individualistic Learning*. Boston, Allyn & Bacon, 1999.

Roger and David Johnson from the University of Minnesota develop ideas about how students should interact with each other to advance learning in this book. They describe three types of interaction: competition, individualistically (not working with other students) and cooperatively. Competition and individualistic learning modes are the most prevalent in schools, but cooperation has become more popular as educators discover how effective this interaction pattern is. Cooperative learning is based on positive goal interdependence yet individual accountability. It is much more than grouping students to work together or one student in a group doing the work for others, especially in terms of the roles students play in the group and their individual accountability.

Slavin, R. E. *Cooperative Learning: Theory, Research and Practice*. Boston: Allyn and Bacon, 1995. Slavin found evidence that cooperative learning that allows students of different races to work together promotes equity in terms of positive racial attitudes and closing the achievement gap. He cautions that cooperative learning, however, must not be just a cosmetic change; it must truly change the way a group of students works together in a class. This book includes elements of cooperative learning that make the practice effective for a variety of goals: achievement, intergroup relationships, positive mainstreaming outcomes and self-esteem, for example.

Learning Styles

Brain studies established that each person's brain is different. Research in education as well as practitioners have, therefore, postulated that people learn differently. A learning styles approach to helping all learners learn helps educators recognize differences and adjust curriculum, instruction and assessment accordingly. Many educators advocate teaching students directly about their own learning styles – and helping them strengthen aspects of their learning that are weak. Self-directed learners are generally aware of their own learning styles. Educators have addressed learning style differences through an instructional practice called differentiation (see C. A. Tomlinson below).

Briggs-Myers, I. (with P. Myers). *Gifts Differing: Understanding Personality Type*. Palo Alto, CA: Consulting Psychologists Press, 1980.

Isabel Briggs Myers was responsible (with the guidance of her mother Katharine Cook Briggs and father Lyman J. Briggs) for creating the most frequently used and respected personality inventory ever, based on C. G. Jung's work and the differences the Briggs family noticed in Isabel's future husband, Clarence "Chief" Myers. The instrument was called the MBTI® (Myers-Briggs Type Indicator). This book describes her work on developing, refining, validating and sharing with others her extraordinary instrument. Her insights into how people perceive the world, respond to it and interact with it continued almost to her death.

Carbo, M., Dunn, R. and Dunn, K. *Teaching Students To Read Through Their Individual Learning Styles*. NY: Allyn & Bacon, 1986.

Marie Carbo developed a reading style inventory that can be taken by all ages in a few minutes. In this book, she describes the different reading styles that children have – their individual strengths (such as global, tactile or kinesthetic) and interests. In addition to the inventory to be used for diagnosis purposes, Carbo also developed a comprehensive reading program, including recorded books. The research that led to her materials and strategies was based on child-development studies; she has conducted a variety of experimental studies on her own work in schools, and others also have produced research studies of its effects.

Jung, C. G., & Baynes, H. G. *Psychological Types or The Psychology of Individuation*. London: K. Paul Trench Trubner, 1923. (Also 1971, Princeton University Press).

Jung's work on types inspired those who followed him to develop instruments that measured types – see Briggs Myers and Carbo above and others below this citation. Jung distinguished between general attitude types and function types. He identified the extroverted type in terms of thinking, feeling, sensation and intuition; and the introverted type according to the same subcategories. Jung also identified archetypes, which were the original of which all others are patterned. Archetypes appear in literature (think Shakespeare) the arts and psychology. Jung's four famous archetypes were the self, the shadow, the anima and the animus.

Kolb, D. *Learning Style Inventory (LSI), Version 3*. England: Experience-based Learning Systems, Inc., 2005.

Kolb proposed four distinct learning styles, each representing two preferred styles: diverging, assimilating, converging and accommodating. Kolb suggested that a person's preferred style developed from acquisition (birth to adolescence) to specialization (school, early work, early adulthood), and finally to integration (mid-career to later life). His work in learning styles led him to develop a theory of experiential learning.

Lawrence, G. *People Types and Tiger Stripes: A Practical Guide To Learning Styles*. Gainesville, FL: Center for Applications of Psychological Type; Oxford Psychologists Press, 2000.

This book is for general audiences and has become a classic in terms of application of the MBTI®. The author maintains that type is not superficial. "It is as unchangeable as the stripes on a tiger." We can understand types (our own and others) and learn, however. This edition of the book contains new topics such as type in an organization and in schools, stereotyping, deeper layers of understanding, research summaries and reflection on the work the author, Gordon Lawrence, has done since its first publication.

McCarthy, B., & McCarthy, D. *Teaching Around the 4MAT® Cycle: Designing Instruction for Diverse Learners with Diverse Learning Styles*. CA: Corwin Press, 2005.

4MAT® was developed in 1979. It is a "natural cycle for delivering instruction" that relates to the different ways people learn: "It appeals to all learners in turn." The system provides for individual preferences along the continua of perceiving and processing. McCarthy's cycle distinguishes among the skills of four learning styles (IF? WHY? HOW? WHAT?) For example, HOW students learn through experimentation, manipulation, improving and tinkering.

Silver, H. F., Strong, R. W., & Perini, M. J. *So Each May Learn: Integrating Learning Styles and Multiple Intelligences*. Alexandria, VA: Association for Supervision and Curriculum Development, 2000.

The authors of this book address the challenges of diversity in a standards-based culture in which high achievement for all is expected. They make the case that multiple intelligences and learning styles offer educators a way to meet this challenge. Integrating these tools results in a holistic model of learning that supports learning. The authors provide rationales and research-based strategies.

Tomlinson, C. A. *The Differentiated Classroom: Responding to the Needs of All Learners*. Alexandria, VA: Association for Supervision and Curriculum Development, 1999.

Like the authors in the citation above, Tomlinson explores the challenge of diversity in classrooms. She describes how educators can match their instructional approaches to the different kinds of learners in each class, including eight principles for a differentiated classroom and 15 instructional strategies. She also suggests giving students choices about how they learn.

Multiple Intelligences

Howard Gardner of Harvard University proceeded from the work of the neuroscientists to develop the concept of multiple intelligences. He refuted concepts that intelligence was a singular dimension (IQ) and that it was immutable. He identified seven intelligences and then added an eighth (although others, such as Sternberg, have identified a few more or less). Gardner's eight intelligences are linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial, interpersonal, intrapersonal and naturalist. A number of researchers and educators have translated his concepts into classroom practice.

Gardner, H. *Frames of Mind: The Theory of Multiple Intelligences*. New York: Basic Books, 1983.

This book explains how and why people learn differently. Gardner refutes IQ (a single dimension of intelligence) and proposes seven types of intelligence that work together to make us the learners we are. He describes early views of intelligence and the biological foundations of intelligence before answering the question, "What is intelligence?" Then he makes a case for multiple intelligences and how they are integrated. Finally, in Part III, he addresses the implications of his theory and its applications.

Gardner, H. *The Unschooled Mind: How Children Think and How Schools Should Teach*, New York: Basic Books, 1991.

Understanding is different from mastering content, in Gardner's mind. This book focuses on early childhood education and how students can seem to know everything they are supposed to know and yet be unable to transfer that knowledge to other situations. Teaching for understanding means restructuring schools. Furthermore, what children learn early in their lives (about gravity, for example) stays with them, even if it is wrong. Gardner advises educators to think of school as an apprenticeship or visiting a museum. Gardner wants students to encounter challenges, like those between belief and reality.

Gardner, H. *Intelligence Reframed. Multiple Intelligences for the 21st Century*. New York: Basic Books, 1999.

In this book, Gardner asks about the ways we measure intelligence, in particular how our measurement tools work. He elaborates on the multiple intelligences (MI) theory he proposed in *Frames of Mind* and the neurological research that supports it. He responds to some myths generated about MI. He cites his work in Harvard's Project Zero that shows improved student performance. He emphasizes his plan for schools oriented toward MI – he wants them to emphasize deep understanding of a few key subjects through a variety of instructional strategies. He predicts differentiated instruction (see Tomlinson above) through a strategy he calls “individually configured education.” It is in this book that Gardner introduces an eighth intelligence: the naturalist intelligence.

Gardner, H. *The Disciplined Mind: Beyond Facts and Standardized Tests, the K-12 Education That Every Child Deserves*, New York: Simon and Schuster, 1999.

Having discussed tools for assessing intelligence in an earlier book, Gardner now returns to the theme of what can be measured and how. He argues that schools should strive for three classical principles: truth, beauty and goodness. He gives examples of schools where those principles operate. Rather than standardized testing, which dictates learning at a very low level, Gardner advocates education that preserves the principles he described.

Gardner, H., & Hatch, T. “Multiple intelligences go to school: Educational implications of the theory of multiple intelligences,” *Educational Researcher*, 18(8), 4-9, 1989.

In this article, Gardner and Hatch discuss the chasm between research psychology and applications of theories related to intelligence. Summarizing the history of the development of the split, they pay tribute to Robert Sternberg for making intelligence central in both research and practice. This article provides a good summary of Gardner's own work, including his refutation of Piaget's view of symbolic systems as single functions, rather than – as Gardner saw it – separate symbolic systems, leading to multiple intelligences. In this article, Gardner discusses his concern that only two forms of symbolic use predominate in schools: linguistic and logical-mathematical. He advocates expanding to a range of intelligences for learning. He describes several projects (Project Spectrum, for example) and several schools that have used MI theory schoolwide and provides research results for them.

Smith, M. K. “Howard Gardner, multiple intelligences and education,” *The Encyclopedia of Informal Education*. On the web at <http://www.infed.org/thinkers/gardner.htm>, 2002.

This Web site provides a great resource for those just beginning their exploration of MI. As Mark Smith says in the introduction, “Here we explore the theory of multiple intelligences; why it has found a ready audience amongst educationalists; and some of the issues around its conceptualization and realization.” This site provides a biography of Gardner and a good bibliography as well.

Sternberg, R. J. *Beyond IQ: A Triarchic Theory of Human Intelligence*. New York: Cambridge University Press, 1985.

As Howard Gardner maintained above, Sternberg was one of the first to posit more than one intelligence. In fact, Sternberg's theory of intelligence had three subtheories: componential (the structure of intelligent behavior, its mental processes), experiential (the task requirements for intelligent behavior exhibited along a continuum from novel to familiar), and contextual (intelligent behavior as required by environment). The components of intelligence, then, are metacognitive, performance and knowledge acquisition. It is the interaction among these subtheories and components that describes intelligence.

Sternberg, R. J. *Successful Intelligence*. New York: Simon & Schuster, 1966.

Sternberg has focused on intelligence, creativity, thinking styles, cognitive modifiability, learning disabilities, love and hate, and wisdom at the PACE Center at Yale University as IBM Professor of Psychology and Education. In this book, Sternberg asks the question, “What is successful intelligence?” and answers it in terms of these abilities: “The ability to achieve success in life in terms of one's personal standards, within one's socio-cultural context. One's ability to achieve success depends on capitalizing on one's strengths and correcting or compensating for one's weaknesses. Balancing of abilities is achieved in order to adapt to, shape and select

environments. Success is attained through a balance of analytical, creative and practical abilities.”

Neuroscience

Neuroscience is the study of how the brain works. Researchers in the neurosciences have made considerable breakthroughs in the past three decades, often as a result of new technologies. One breakthrough is data proving that the brain changes – and is changeable – throughout our lives. How we use the brain affects the structure of the brain. In terms of education, neuroscience has shown we can change connections in the brain as we use it. We strengthen old patterns and make new patterns (schema), which become our memories. Neuroscience has influenced education in terms of experiential learning, whole-to-part learning, metacognition, and schema theory.

Caine, R. and Caine, G. *Making Connections: Teaching and the Human Brain*. Alexandria, VA: Association for Supervision and Curriculum Development, 1991.

Renate and Geoffrey Caine synthesize brain research in this book, focusing on how the brain makes connections between past knowledge and current experiences. They focus on how schools promote – or fail to promote – these connections. This book describes a set of 12 principles for brain-based learning, such as “The mind/brain is a complex adaptive system” and “The search for meaning is innate.”

Edelman, G. *Bright Air, Brilliant Fire: On the Matter of the Mind*. New York: Basic Books, 1992.

Edelman is director of the Neurosciences Institute and president of the Neurosciences Research Foundation; he is professor at the Scripps Research Institute. Edelman’s work has resulted in a theory – “neuronal group selection” – to explain how the higher brain works (develops and organizes itself). He presented his biologically based theory of consciousness in *The Remembered Present* and elaborates on it in this book, in which he explores the implications of his theories (including his ideas about neural evolution).

Gardner, H. *The Mind's New Science: A History of the Cognitive Revolution*. (With a New Epilogue, *Cognitive Science After 1984*). New York: Basic Books, 1985.

Reading this book led to my own interest in cognitive science. It introduced me to the studies in a variety of fields – philosophy, psychology, artificial intelligence, linguistics, anthropology and the neurosciences – that led to a new idea about learning, all according to their separate but congruent emerging epistemological aspects. Gardner proposed an integrated field of cognitive science in terms of perceiving the world, mental imagery, categorization, and rational and logical thinking. His discussion of the history of mind and intelligence is helpful, as is his description of the emerging science of cognition.

Gordon, E. *Integrative Neuroscience: The Big Picture*. The Netherlands: Overseas Publishers Association, 2000.

This textbook integrates the boundaries of specific disciplines in terms of studying the neurosciences. It provides detailed information about brain science across these disciplines: evolution, philosophy, anatomy, chemistry, computer science, brain dynamics, psychology, neurology, psychiatry, psychotherapy and brain imagery.

Matthews, G. B. *11th Hour: Introduction to Neuroscience*. United Kingdom: Blackwell Publishing, 1999.

Part of a series of books for college students, this book by Matthews (from the State University of New York at Stony Brook) is designed for quick reference. Students can take a test on the content at the end of each chapter and consult explanations for the correct answers, even follow icons in the text to support on a webpage. A good way to learn about neuroscience!

Sylwester, R. *Celebration of Neurons*. Alexandria, VA: Association for Supervision and Curriculum Development, 1995.

Sylwester, originally a biologist, has synthesized brain research in terms of application to education. Once a teacher in a one-room school, Sylwester rejected behavior modification (behaviorism) and focused on the cognitive sciences. He discusses how the brain is organized to learn, how adolescents’ brains work, how a collaborative classroom assists brains in learning and other topics.

Thompson, R. F. & Madigan, S. A. *Memory: The Key to Consciousness*. Washington, DC: National Academies Press, 2005.

This book is the second in a series called Science Essentials. It presents the basics on the mechanics of memory and learning. In the field of the behavioral and neurosciences, there has been an explosion of knowledge about the brain, resulting in an applied science devoted to studying memory. This book summarizes the research and its applications.

Piaget's Developmental Theory

Piaget's theory of learning described how children build cognitive structures over time. Piaget mapped the increased sophistication with which children responded to and understood their environments. He called his theory "genetic epistemology" and identified four stages: sensorimotor stage (infancy), pre-operational stage (toddler and early childhood), concrete operational (elementary and early adolescence), and formal operational adolescence and adulthood). Piaget is somewhat discredited currently because of the limitations of his research (his own children were his primary research subjects) and because of his single definition of intelligence.

Jean Piaget Society. *Cognitive Development*, official journal of the society, published quarterly by Elsevier.

Mooney, C. G. *Theories of Childhood: An Introduction to Dewey, Montessori, Erikson, Piaget & Vygotsky*. St. Paul, MN: Redleaf Press, 2000.

An excellent introduction for educators involved in early childhood education. The author, a Harvard graduate and former Head Start teacher, presents the theories these educational researchers espoused, as well as applications in the classroom.

Piaget, J. *A Child's Conception of the World*. A 20th-Century Classic of Child Psychology. Littlefield Adams Quality Paperbacks, 1929.

This new edition of one of Piaget's first published study describes the methods he used and then focuses on how people perceive reality. He discusses realism, thought, dreams, the consciousness of self with others, the consciousness of things, the concept of life, moral necessity and physical determinism, artificialism (perceptions of the sun, moon, water, stars, earth, etc.).

Piaget, J. & Inhelder, B. *The Psychology of the Child*. New York: Basic Books, 1969, 2000.

This is one of the last books Piaget published. It brings together his thinking about the sensori-motor intelligence, the construction of reality, the cognitive and affective aspects of sensori-motor reactions, the development of perception, semiotic (symbolic) function, the concrete operations of thought and interpersonal relations, and the preadolescent and propositional operations.

Singer, D. G. & Revenson, T. A. *A Piaget Primer: How a Child Thinks (Revised Edition)*. Plume Books, 1996.

This book makes Piaget accessible to the general reader. Written well, it also uses children's literature and popular comics to make Piaget's work understandable, even for non-psychology majors. Among the concepts discussed in this book are assimilation and accommodation, stages of development, play, language development, number concept and moral development. The book ends with implications of the theories on early childhood education.

Right Brain/Left Brain Thinking

Research in the neurosciences revealed that there are two main parts of the brain, the right side and the left side. Experimentation has shown that different abilities correspond to each side. The left side of the brain (left brain) is primarily logical, analytical, sequential, objective and rational. The right side of the brain (right brain) is primarily intuitive, holistic, subjective and focused on whole-to-part thinking. Educators are coached to teach in ways that appeal to one side or the other – or both sides of the brain. There is some skepticism among scientists and educators about treating the two parts of the brain as separate.

Asher, James J. *The Super School: Teaching on the Right Side of the Brain*. Los Gatos, CA: Sky Oaks Productions, Inc., 2000.

This book focuses on schools using Total Physical Response (TPR), especially for learning a second language. The benefits of a TPR (right-brain approach) are that it results in instant understanding, high-speed, long-term retention and is natural and, therefore, stress-free. The premise is that people acquire another language as they acquire their first language – they comprehend before they speak. Comprehension and talking are located in different parts of the brain; if both are required at the same time (listen to what I say and say it), there may be “brain overload,” the frontal lobe and the temporal lobe in the brain trying to operate at the same time. Asher and others who use his strategies claim that we must teach through an alternative to translation (which complicates learning through being contradictory).

Asher, James J. *Brainswitching: Learning on the Right Side of the Brain*. Los Gatos, CA: Sky Oaks Productions, Inc., 2002.

Originator of Total Physical Response (TPR), Asher focuses on second language learning from the point of view of the brain. He makes the case that learning another language is usually an ineffective left-brain (logic) approach and advocates that a right-brain approach works much better. This book addresses not just language but also mathematics and science learning.

Battro, A. M. *Half a Brain is Enough: The Story of Nico*. United Kingdom: Cambridge University Press, 2000.

This book is the poignant story of a young boy who at age 3 was given a hemispherectomy to control epilepsy. An Argentinian physician and cognitive psychologist, Battro, wrote this case history that is more than a story of one boy who has only half a brain. Battro claims his work with Nico changed himself profoundly. The result, this book, is a meditation on consciousness, cognition and how the brain works. With the right brain excised, Nico’s brain began to compensate for its loss; the left side of his brain gained new capacities (and capacity) and became quite efficient. New brain technologies (such as PET and the fMRI) made it possible to study Nico’s brain non-invasively. Battro’s key question is how half of a brain can equal a full mind, but he also addresses the implications of his discoveries in education: “What can we do to put more brain into education?” Battro discusses the equivalent of the “www” in our heads.

Hellige, J. B. *Hemispheric Asymmetry: What’s Right and What’s Left*. Cambridge, MA: Harvard University Press, 1993.

Hellige, a professor of psychology and vice provost for academic programs at the University of Southern California, describes hemispheric asymmetry and interhemispheric interaction. He describes the cerebral cortex as anatomically separated into two hemispheres. Although the right and left are similar, they are not exactly alike in terms of what they do and how they work. Working together they produce whole experiences resulting in perception, cognition and action.

Hellige J. B. “All the king’s horses and all the king’s men: Putting the brain back together again,” *Brain and Cognition*, 42, 7-9, 2000.

Hellige makes the point that there are differences between the right and left hemispheres of the brain, but he also says there are similarities. Both brain hemispheres are able to engage in a number of different activities, although sometimes with variety in ability. Left-hand/right-hand differences is one area in which the brain is divided, and production of speech seems to be related to being left- or right-handed. Over 90% of those who are right-handed produce speech from the left side of the brain, but the opposite is not true. Hellige states, “In most domains the two hemispheres make complementary contributions.”

Hugdahl, K, and Davidson R. *The Asymmetrical Brain*. MA: MIT Press (A Bradford Book), 2002.

This book presents the latest research on brain asymmetries and function. New technologies such as MRI, fMRI, PET, MEG and TMS, make it possible to identify what parts of the brain work separately and together in terms of function. Clinical applications are described as well as animal models and basic functions; neuro-imaging and brain stimulation studies; visual, auditory and emotional laterality; and neurological and psychiatric disorders. The 2002 book is an update on a 1995 book.

McCarthy, B. *Four-Mat System: Teaching to Learning Styles with Right-Left Mode Techniques*. Wauconda, IL: About Learning, Inc., 1980.

This book makes two points: (1) People have major learning styles (see Learning Styles above) and (2) People have hemisphere processing preferences (right/left hemispheres of the brain). Although all people undergo the processes of feeling, reflecting, thinking and doing, they individually decide when and how to do these activities. These ideas led to the 4MAT® system based on eight theoretical approaches to learning: connection, examining, imaging, informing, practicing, extending, refining and performing.

Meador, K., Loring, D., Helman, S., Vazquez, B. & Neveu, P. "Role of cerebral lateralization in control of immune processes in humans," *Annals of Neurology*, 55:6, May 24, 2004, 840-844.

This article is not for the faint-of-heart! It makes the case that cerebral lateralization – the different effects of left- and right-brain functions – may make a difference in terms of immune function. The effect has been observed in animals in terms of epilepsy, but not in humans. The findings demonstrate that resections in the language nondominant hemisphere increased some cellular elements. The authors make a connection between immune functions and learning in terms of different sides of the brain.

Vygotsky and Social Cognition

Russian Lev Vygotsky blended a constructivist theory of learning with ideas about how culture and social relationships impact learning. He posited that we learn through dialectical processes, working with others on important problems. Groups of learners offer different skills, knowledge, experiences and ideas, and, thus, build "scaffolding" for each other to solve problems and learn. A "zone of proximal distance" describes what a learner can do on his or her own and what the learner can do when offered assistance from others. Learning in groups is of critical importance to the learning of each individual.

Heath, S. B. *Ways with Words: Language, Life and Work in Communities and Classrooms*. Cambridge, United Kingdom: Cambridge University Press, 1983.

In this book, Shirley Brice Heath, an ethnographer, presented the results of her study of literacy in a single town in the Piedmont with two separate cultures, which she named Roadville and Trackton. She described the townspeople and the oral and literate traditions of both cultures, as well as how infants learned to talk in both cultures, giving lots of examples from her studies. She defined literacy as a social phenomenon.

Vygotsky, L. S. (Alex Kozulin, Ed.) *Thought and Language*. Cambridge, MA: MIT Press, 1962, 1986, original work published 1934.

Soviet psychologist Vygotsky was a founder of Moscow's Institute of Defectology in 1924. "Defectology" was the term used to describe special education. Vygotsky even then was aware that disabilities were social facts, the limitations they imposed on individuals mostly social. Although he did not go on to concentrate on disabilities, he did posit a cognitive theory that all higher-order mental processes, such as language use, voluntary attention and logical memory, originate in social relationships. Speech acts between a child and parent are an external activity in a social situation that yield language learning. Internalized social relationships, therefore, lead to higher mental processes. In this book, Vygotsky makes the point that "culture becomes part of each person's nature." He also presents his theory of the zone of proximal development to describe how learning and cognitive development occur simultaneously in social situations wherein adult guidance or peer expertise helps a novice learn something new. The "zone" is the distance between independent problem solving and assisted problem solving – a good place for learners to reside. This theory contradicted Piaget's theory that learning activities should match a child's level of mental development.

Vygotsky, L. S. (Edited by M. Cole, V. John-Steiner, S. Scribner, E. Souberman). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press, 1978.

This book introduces readers in the western world to socio-historical psychology. According to the editors, westerners did not understand Vygotsky's theory of development. The book consists of a selection of Vygotsky's most important writings. It includes Vygotsky's thoughts on tools and symbols in child development, perception and attention, memory and thinking, higher

psychological functions. It also addresses educational implications, the interaction between learning and development, the role of play in development and the prehistory of written language. Overall, the book focuses on how individual human intelligence develops within a society or environment. It discusses cognitive tools that help people think, such as talking to oneself or others in order to solve a problem or figure out something.

**EAGLE ROCK SCHOOL & PROFESSIONAL DEVELOPMENT CENTER
COMMONLY HELD BELIEFS
ABOUT TEACHING AND LEARNING (PEDAGOGY)**

Learning occurs when people are:

- Doing, experiencing
- Experiencing new input or stimulus
- Practicing, reinforcing and repeating or extending what they know
- Working according to their passions and interests
- Teaching others
- Applying what they are learning
- Problem solving or struggling with ideas
- Relating what they are learning to themselves; learning about what they value
- Discovering and understanding their place in the world
- Feeling empowered to act
- Working in a safe environment
- Motivated (feeling some desperation!)
- Reflecting
- Feeling as if they are having fun
- Part of a continuous connected process of learning
- Learning according to their own style or preferences

Lois Brown Easton is a nationally recognized expert and author on curriculum, student learning and strategies for teachers' professional development.

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