# Building Expertise

## Cognitive Methods for Training and Performance Improvement

*Third Edition*

Ruth Colvin Clark

Pfeiffer
A Wiley Imprint
www.pfeiffer.com

# About This Book

## Why Is *Building Expertise* Important?

This is a book about the psychology of expertise and how instructional professionals can leverage mental processes to grow expertise in the workforce.

Whether you are a class facilitator, course developer, or both, your job is to build expertise. There are many books available on the *how's* of training, full of useful tips and techniques. But for the most part, these books don't explain the *why's* behind the how's. Unlike what's in these books, I present guidelines based on how people learn and on evidence of what works during learning. What distinguishes a professional from a paraprofessional approach to education and training is a depth of understanding of how learning occurs and how to adapt evidence-based guidelines to unique situations.

## What's New in the Third Edition?

In the 21st Century, the global economy has become a reality. To stay competitive, organizations must increasingly rely on innovation—innovation emerging from expertise that can be adapted to diverse and unpredictable contexts. Throughout this new edition, I draw on evidence about how to build innovative forms of expertise and translate that evidence into useful guidelines for instructional professionals.

I have rewritten all of the chapters that appeared in the second edition. In some cases, I divided chapters to reduce the mental load. In my rewrite, I updated the research on the various techniques discussed throughout the book. Since the second edition, we have seen growth in e-learning with expansions into synchronous as well as asynchronous delivery methods. I have incorporated new examples to reflect these changes.

Finally, this is the first time *Building Expertise* has benefited from a professional production effort. Newly published by Pfeiffer, this edition reflects professional editing and layout.

## What Can You Achieve with This Book?

If you are a designer, developer, facilitator, or evaluator of instructional environments for classroom or digital delivery, you can use the guidelines in this book to

ensure that your courseware meets human psychological learning requirements. In particular you can learn the best ways to build expertise by:

- Reducing unproductive mental load during learning
- Directing attention
- Leveraging prior knowledge of your learners
- Helping learners build new mental models through implicit and explicit training methods
- Supporting transfer from the instructional environment to the workplace
- Using guided discovery design architectures that build problem-solving skills
- Building mental monitoring and learning management skills
- Motivating learners to invest the effort needed to build expertise

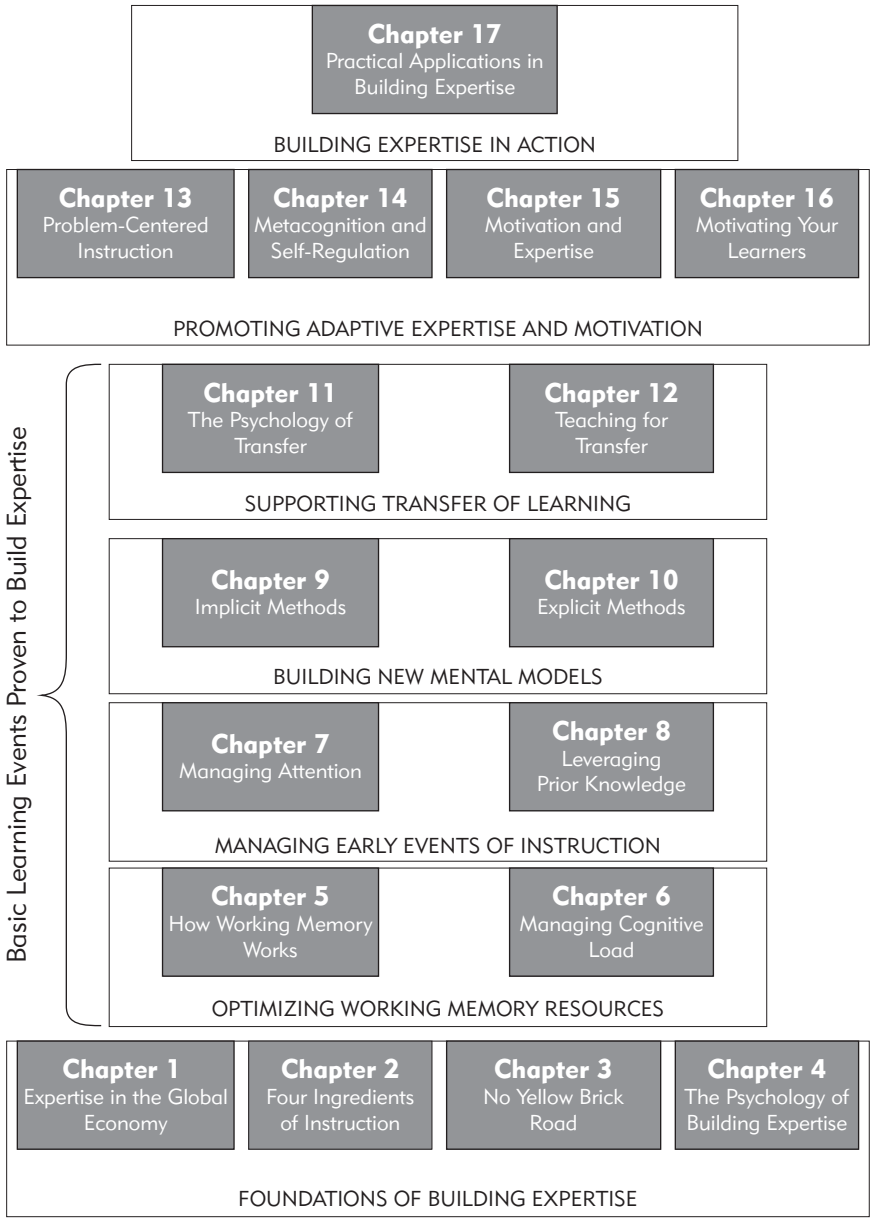
## How Is This Book Organized?

From music to chess to programming, psychologists have learned a great deal by studying experts in various domains. Part I includes Chapters 1 through 4, which lay the foundation for the book by summarizing what recent research tells us about expertise—what it is and how it grows. These chapters introduce key concepts relevant to the rest of the book, including the features of expertise, four learning architectures, and an overview of how learning happens.

Part II is the heart of the book, containing eight chapters that focus on the core psychological learning events proven to build expertise. These chapters explain the psychology of each learning event and describe techniques to:

- Minimize unproductive mental load in working memory
- Support early events of instruction, including focus of attention and activation of prior knowledge
- Help learners build mental models through implicit and overt activities
- Create an environment that promotes transfer of learning to the workplace

**Figure I.1. The Structure of Building Expertise**



In Part III, I shift the focus to adaptive forms of expertise that are the basis for creative and critical thinking skills. In Chapter 13, you will learn about problem-centered learning environments that lead to adaptive expertise. In Chapter 14, I focus on how to build mental monitoring skills called metacognition. Finally, motivation fuels the engine that drives the effort required to build expertise. In Chapters 15 and 16, I look at recent research findings on instructional strategies you can use to promote optimal motivation.

The final chapter integrates the ideas of the book by describing instructional programs I have designed based on three of the instructional architectures introduced in Chapter 2 and summarizes guidelines for building adaptive forms of expertise through exploratory learning environments that encourage critical and creative thinking.

# About Pfeiffer

Pfeiffer serves the professional development and hands-on resource needs of training and human resource practitioners and gives them products to do their jobs better. We deliver proven ideas and solutions from experts in HR development and HR management, and we offer effective and customizable tools to improve workplace performance. From novice to seasoned professional, Pfeiffer is the source you can trust to make yourself and your organization more successful.

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*Essential resources for training and HR professionals*

# Building Expertise

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*Third Edition*

Ruth Colvin Clark

Pfeiffer
A Wiley Imprint
www.pfeiffer.com

Published by Pfeiffer
An Imprint of Wiley
989 Market Street, San Francisco, CA 94103-1741
www.pfeiffer.com



**Library of Congress Cataloging-in-Publication Data**

Clark, Ruth Colvin.
Building expertise : cognitive methods for training and performance improvement / Ruth Colvin Clark. — 3rd ed.
p. cm.
Includes bibliographical references and index.
ISBN 978-0-7879-8844-9 (cloth)
1. Employees—Training of. 2. Learning, Psychology of. I. Title.
HF5549.5.T7C5882 2008
658.3'124—dc22

2008021037

Acquiring Editor: Matthew Davis
Director of Development: Kathleen Dolan Davies
Developmental Editor: Leslie Stephen
Production Editor: Dawn Kilgore
Editor: Rebecca Taff
Editorial Assistant: Lindsay Morton
Manufacturing Supervisor: Becky Morgan

Printed in the United States of America

*Printing* 10 9 8 7 6 5 4 3 2 1

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# Introduction to the Third Edition

## GETTING THE MOST FROM THIS RESOURCE

## Purpose

Building expertise is the central challenge of all instructional practitioners. Yet few know the psychology or the evidence underlying training methods that lead to expertise. The training field is evolving from a craft based primarily on fads and folk wisdom to a profession that integrates evidence into the design and development of its products. A professional knows not only what to do but why she is doing it and how she might adjust techniques to accommodate different learners or diverse learning outcomes. Professionals can summarize the research behind their recommendations to their stakeholders. Because everyone who has gone to school considers him- or herself a learning expert, instructional practitioners face a unique challenge to establish themselves as professionals to their clients and their learners.

In this book you will learn techniques to build expertise. But just as important, you will learn the psychological reasons and the evidence for those techniques.

## Audience

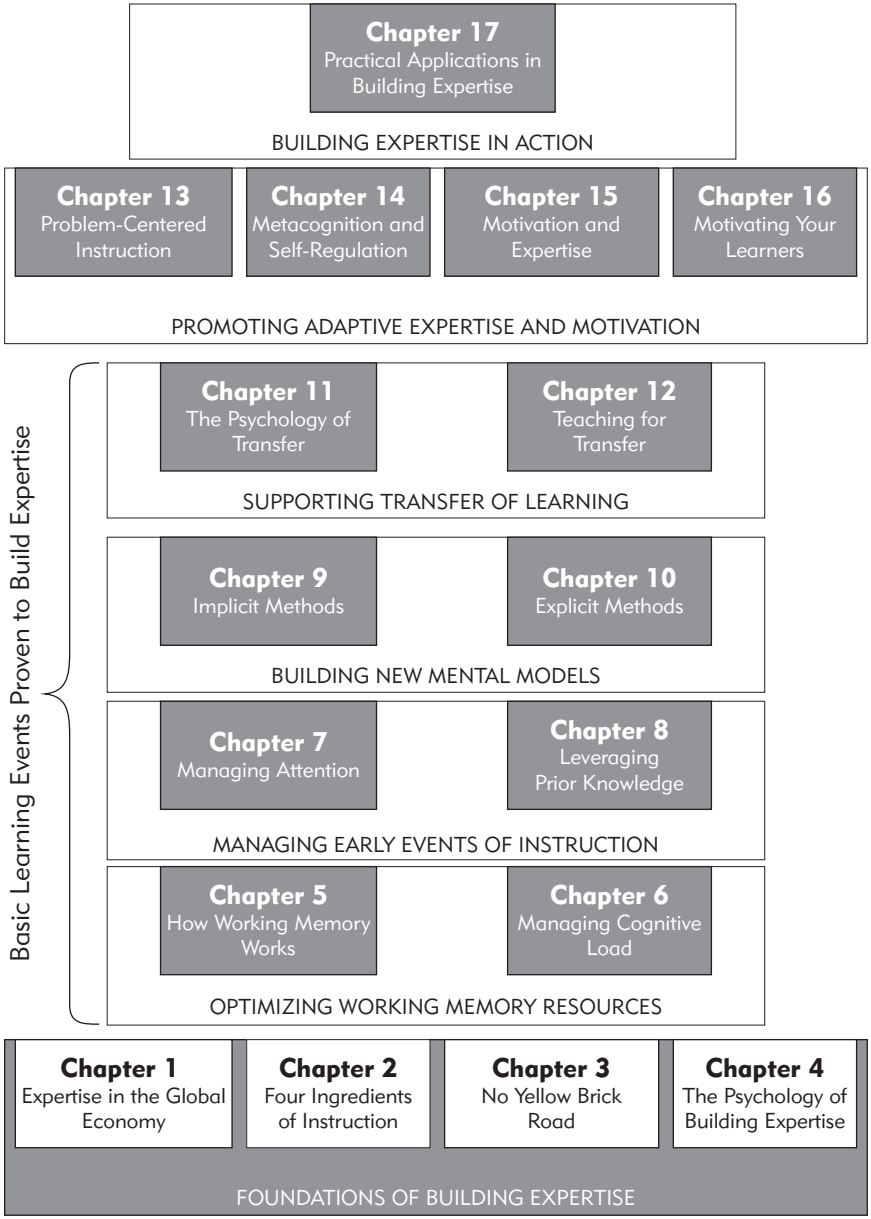
If you are a facilitator, designer, developer, evaluator, or consumer of training, you can use the guidelines in this book to identify learning environments that accelerate expertise. Although most of my examples are drawn from workforce learning, I believe that educational professionals can also benefit from these guidelines.

## Package Components

The heart of the book is the seventeen chapters summarized in Figure I.1. Most chapters are organized around a pivotal psychological event involved in learning. These chapters summarize the psychology and illustrate training techniques that support each learning process. You will not only read about the techniques, but review evidence for them as well as application examples. At the end of each chapter you will find some references that offer more in-depth or technical information on the chapter topic.

## Glossary

A glossary provides definitions of technical terms that appear throughout the book.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FOUNDATIONS OF BUILDING EXPERTISE

PART ONE

# Foundations of Building Expertise

**HOW HAS** the 21st Century global economy driven the need for adaptive forms of expertise that are the basis for innovation? What has recent research on experts from sports to medicine told us about how to efficiently grow expertise?

In Chapters 1 through 4 I lay the foundation for *Building Expertise* by summarizing recent research on expertise as well as describing the key ingredients and psychological events essential to any instructional program that supports expertise.

## CHAPTER 1 TOPICS

**The Value of Expertise**

The Challenge of Global Expertise

**What Is an Expert?**

**Seven Lessons Learned About Experts**

1. Expertise Requires Extensive Practice
2. Expertise Is Domain Specific
3. Expertise Requires Deliberate Practice
4. Experts See with Different Eyes
5. Experts Can Get Stuck
6. Expertise Grows from Two Intelligences
7. Challenging Problems Require Diverse Expertise

# 1

# Expertise in the Global Economy

*An expert is a man who has made all the mistakes that can be made in a very narrow field*

NEILS BOHR

**WHAT IS AN EXPERT?** How do people become experts? Is expertise a matter of talent or learning? What types of expertise are most needed in the new global economy? How can instructional professionals make use of what we know about experts to build more effective learning environments? This chapter sets the stage for the book by summarizing what we know about expert performance and why effective training programs are critical to organizations facing the competitive pressures of a growing global pool of expertise.

## The Value of Expertise

If you have taken an airplane trip, consulted a medical professional, used computer systems, or attended a professional ball game or a concert, you have benefited from expertise! In fact, few

of us would get through a normal week were it not for the varied expertise that provides the infrastructure for our many daily activities. This is a book about expertise—specifically how to grow and deploy expertise most effectively to achieve organizational goals.

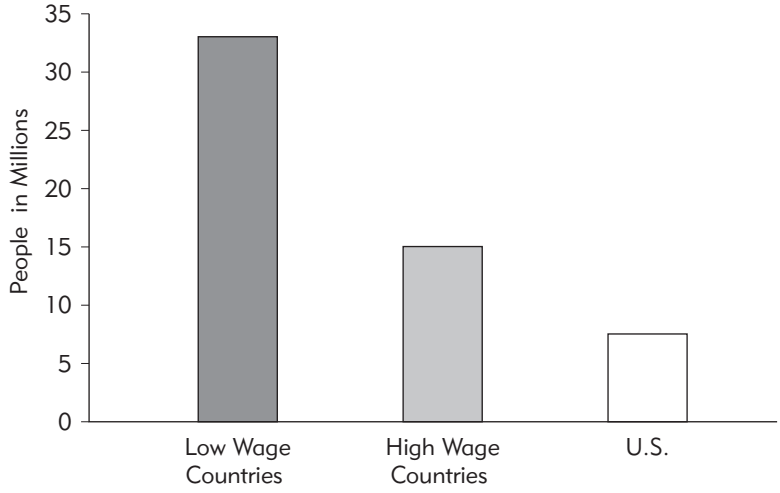
There is a large untapped reservoir of knowledge about how novices become experts and how that transition can be facilitated through training and other workplace solutions. In fact, as I write this third edition of Building Expertise, the research on expertise has grown sufficiently to warrant a new forty-two-chapter book: Cambridge Handbook of Expertise and Expert Performance, published in 2006! Knowledge about expertise is untapped in part because much of the recent research on human learning and expertise is buried in academic resources such as the Cambridge Handbook not routinely accessed by practitioners.

Instructional professionals like you who are responsible for the growth of expertise in your organization can benefit from this research. In other words, you need expertise on expertise. My objective in this book is to summarize the research and psychology about what we currently know about growing and leveraging expertise in organizational settings.

## The Challenge of Global Expertise

Workers in developed countries face increasing global competition for expertise. Uhalde and Strohl (2006) estimate as many as forty million American jobs, equivalent to nearly a third of the U.S. labor force are theoretically vulnerable to off shoring. The expanding global pool for the type of higher level skills that have historically been the province of developed nations comes from the BRIC (Brazil, Russia, India, and China) supply chain. Since the turn of the century, 1.5 billion people from China, India and countries from the former Soviet bloc have joined the global labor force. Data from a 2005 McKinsey report summarized in Figure 1.1 show young professionals from low-wage countries, including engineers, finance analysts and accountants, and

**Figure 1.1. Young Professionals in the Global Talent Pool, 2005**
From McKinsey, 2005




generalists with university degrees make up the largest segment in the global talent pool. And foreign skilled professionals will continue to be inexpensive for several decades to come making some forms of expertise in Western workforces less competitive.

An organization's ability to innovate becomes the competitive edge in a global economy. "The need to innovate is growing stronger as innovation comes closer to being the sole means to survive and prosper in highly competitive and globalised economies" (David & Foray, 2003, p. 22). Therefore a recurrent theme in this book is the psychology of expertise—especially adaptive expertise that is the basis for creative and critical thinking.

## What Is an Expert?

According to Wikipedia (2007), an expert is "someone widely recognized as a reliable source of technique or skill whose faculty for judging or deciding rightly, justly, or wisely is accorded

authority and status by the public or their peers. An expert, more generally, is a person with extensive knowledge or ability in a particular area of study". Wikipedia, one of a growing cadre of open-access software, did not exist at the writing of the second edition of this book and illustrates one way that expertise can be deployed through the Web 2.0.

Of course, expertise is not all or nothing. As one begins to learn a new set of skills, one evolves from novice through various skill levels up to expert or master performer. Table 1.1 summarizes the common labels and attributes associated with stages of expertise. As training professionals we encounter diverse levels of expertise in the course of our work. We may interview subject-matter experts who are, as the name implies, experts or even

**Table 1.1. Levels of Expertise**

| *Level* | *An Individual Who* |
|---|---|
| Novice | Has minimal exposure to the field |
| Apprentice | Has completed a period of study beyond introductory level and is usually working in a domain under supervision |
| Journeyman | Can perform routine work unsupervised |
| Expert | Is highly regarded by peers; whose judgments are uncommonly accurate and reliable; whose performance shows both skill and economy of effort; and who can deal with unusual or tough cases |
| Master | Can teach others; a member of an elite group of experts whose judgments set regulations, standards or ideals |

Based on Chi, 2006

master performers. Our learners are often at the novice or apprentice stages. Our training goals are often relatively modest in scope, perhaps to bring a novice closer to an apprentice level, or perhaps to teach a journeyman a new set of specialized skills or knowledge. As instructional professionals however, we are collectively responsible for the investment of close to $60 billion a year in the United States alone devoted to the growth of the specialized expertise that makes our organizations competitive (Industry Report, 2007).

## Seven Lessons Learned About Experts

Psychologists have studied experts in a variety of domains, including sports, medicine, programming, music, and chess to see how they are different from less-skilled individuals. Here are the main lessons learned from that research:

### 1. Expertise Requires Extensive Practice

As you can see in Table 1.2 world-class experts start early in life and pursue their vocations through many years of prolonged and

**Table 1.2. Years of Practice to Achieve World-Class Performance**

| *Domain* | *Starting Age* | *Years to International Performance* | *Age of Peak Performance* |
|---|---|---|---|
| Tennis | 6.5 | 10+ | 18 to 20 |
| Swimming | 4.5 | 10 | 18 to 20 |
| Piano | 6 | 17 | NA |
| Chess | 10 | 14 | 30 to 40 |

*Source:* Ericsson, 1990

concentrated practice. While an acceptable level of performance in many tasks such as typing or tennis can be reached in a matter of a few weeks or months, high levels of expertise demand years of practice. Some of the first research focused on master-level chess players. About ten years of sustained chess practice is needed to reach master levels. In fact, from sports to music to programmers, the ten-year rule has proved pretty consistent. "Until most individuals recognize that sustained training and effort is a prerequisite for reaching expert levels of performance, they will continue to misattribute lesser achievement to the lack of natural gifts, and will thus fail to reach their own potential" (Ericsson, 2006, p. 699). In other words, while innate ability is one factor that contributes to expertise, most of us do not invest the level of practice needed to fully exploit the talents we have.

While most practice takes place on the job, as a trainer or instructional designer, you can leverage what we have learned about accelerating expertise through appropriate practice during training. For example, after twenty-five hours of study with a computer training simulator called Sherlock, learners with about two years of experience achieved a level of expertise that matched technicians with ten years of experience (Gott & Lesgold, 2000)! Acceleration of expertise can be achieved when training is designed on the basis of human psychological learning processes.

## 2. Expertise Is Domain Specific

Because someone is an expert chess player, will he or she be better prepared to solve a problem in physics? In general, the answer is no! Fields of expertise are very narrow. That's because expertise relies on a large body of *specific* knowledge accumulated over time in memory. Master-level chess players, for example, store over 50,000 chess plays in memory (Simon & Gilmartin, 1973).

These play patterns were acquired gradually over a ten-year period. Successful programmers solve new programming problems by drawing on specific programming strategies that have worked for them in the past.

Studies of expert performers show that concrete and specific knowledge stored in memory is the basis for expertise. Each job domain will require a unique knowledge base and a specialized educational and developmental program to build it. When it comes to high levels of expertise, there are no generic or quick fixes!

## 3. Expertise Requires Deliberate Practice

Although a long period of practice is needed, not everyone who invests a great deal of practice time will achieve high proficiency levels. We are all familiar with the recreational golfer who spends many hours playing, but never really moves beyond a plateau of acceptable performance. Ericsson (2006) distinguishes between *routine practice* and *deliberate practice*. For example, he found that all expert violinists spent over fifty hours a week on music activities. But the best violinists spent more time per week on activities that had been *specifically tailored* to improve their performance. Typically, their teachers identified specific areas of need and set up practice sessions for them. "The core assumption of deliberate practice is that expert performance is acquired gradually and that effective improvement of performance requires the opportunity to find suitable training tasks that the performer can master sequentially. . . . typically monitored by a teacher or coach" (Ericsson, 2006, p. 692). Deliberate practice requires good performers to concentrate on specific skills that are just beyond their current proficiency levels.

## 4. Experts See with Different Eyes

A profession that relies on visual discrimination such as radiology provides a salient example of seeing with different eyes.

Even experienced physicians rely on the unique expertise of the radiologist to review various forms of medical imagery and provide interpretations However, experts from all domains "see" the problems they face in their domains with different eyes than those with less experience. A programmer looking at code, a chess player viewing a mid-play board, or an orchestral conductor scanning the musical notation and hearing the symphony—all take in relevant data and represent it in ways that are unique to their expertise. As a result of their unique representations, they can choose the most appropriate strategies to solve problems or improve performance. Part of building expertise is to train the brain to "see" problems through the eyes of an expert; in other words, to build the ability to represent problems in ways that lead to effective solutions.

## 5. Experts Can Get Stuck

While expert performance is very powerful, expertise has its down sides. For example, based on their extensive experience, experts can be inflexible; they can have trouble adapting to new problems—problems that will not be solved by the expert's well-formed mental models. Bias is a facet of inflexibility. In presenting hematology cases or cardiology cases to medical specialists such as hematologists, cardiologists, and infectious disease specialists, Chi (2006) reports that specialists tended to generate hypotheses that corresponded to their field of expertise *whether warranted or not.*"This tendency to generate diagnoses about which they have more knowledge clearly can cause greater errors" (p. 27).

An advantage of any organization competing in a global talent pool is innovative and creative expertise. Uhalde and Strohl (2006) point to thinking and reasoning competencies including critical thinking, originality, innovation, inductive and deductive reasoning, and complex problem solving as critical to the new economy. Therefore, seeking ways to build flexible expertise that is the source of innovation is an increasingly important goal.

## 6. Expertise Grows from Two Intelligences

Bransford and his colleagues (2006) distinguish between *routine expertise* and *adaptive expertise*. Routine experts are very effective solving problems that are representative of problems in their domain. They are adept at "seeing" and efficiently solving the problem based on their domain-specific mental models. The medical experts mentioned in the previous paragraphs are examples of routine experts. In contrast, adaptive experts evolve their core competencies by venturing into new areas that require them to function as "intelligent novices."

Cattell's (1943, 1963) concepts of crystallized and fluid intelligence align well with the distinction between routine and adaptive expertise. *Fluid intelligence* is the basis for reasoning on novel tasks or within unfamiliar contexts; in other words, it gives rise to adaptive expertise. In contrast, *crystallized intelligence* is predicated on learned skills such as mathematics and reading and is the basis for routine expertise. "In this view, crystallized abilities are essential in the development of well-organized knowledge structures that lead to expertise, while fluidization requires that learners revise existing problem-solving strategies, assemble new ones, search for new analogies, or new perspectives" (Neitfeld, Finney, Schraw, & McCrudden, 2007, p. 511).

In a test of four dominant theories of intelligence, Nietfeld and his co-authors (2007) found that the crystallized-fluid theory of intelligence best fit their data. Important for our perspective as trainers is that both crystallized and fluid abilities can be developed. The research team suggests that initial lessons should "provide background knowledge in a direct instruction format (crystallized abilities) followed by discovery or inquiry based formats enhanced with cooperative learning projects that emphasize the abstraction, transfer, and application of important classroom concepts (fluid ability)" (p. 511).

An emphasis on innovative or creative thinking as a source of competitive edge suggests the need to encourage adaptive types of expertise or fluid intelligence through education, training and organizational policies and practices. In Part III of this book, I discuss instructional approaches that support adaptive forms of expertise.

## 7. Challenging Problems Require Diverse Expertise

Because expertise tends to be extremely specific and because most problems that face large organizations are complex enough to require diverse expertise, increasingly, innovation will depend on what psychologists call *distributed cognition*. One example of distributed cognition is found in work teams. Effective teams made up of multidisciplinary experts are the key to solving many challenging problems. Accomplishments based on teamwork are more the rule than the exception. For example, contrary to the myth of the lonely scientist, most modern scientific findings today are the result of research teams working collaboratively. In the medical arena, health care depends on the effective interaction of the nurse, laboratory technician, radiologist, and primary and specialty physicians.

Distributed expertise suggests that those responsible for expertise in organizations consider not only training but other vehicles for the leveraging of diverse skills. The evolution of the Web-2 with social software such as wikis opens new channels for distributed expertise in organizations. You can deploy valuable expertise throughout your organization with knowledge management techniques that use participative technology. For example, experienced sales professionals post proposal templates and examples on the corporate website. Or experienced technicians contribute to a maintenance wiki that includes troubleshooting decision trees for unusual failures as well as stories—stories indexed to specific equipment failures.

Expertise, both routine and adaptive, is an essential asset to any organization. Training and performance improvement professionals are entrusted with designing work environments that effectively build and distribute expertise in organizations. In *Building Expertise* you will learn about research-based instructional methods that lead to organizational expertise.

COMING NEXT

## Four Ingredients of Instruction

We've seen that expertise is the product of mental models that develop over long periods of time, with the highest levels of expertise growing out of deliberate practice. In the next chapter, I present an overview of four key components in any training program: delivery media, communication modes, instructional methods, and design architectures. Your decisions about these components will define the success of your efforts to build expertise in your organization.

### Suggested Readings

Chi, M.T.H. (2006). Two approaches to the study of experts' characteristics. In K.A. Ericsson, N. Charness, P.J. Feltovich, & R.R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance*. New York: Cambridge University Press.

Ericsson, K.A., Charness, N., Feltovich, P.J., & Hoffman, R.R (Eds.). (2006). *The Cambridge handbook of expertise and expert performance*. New York: Cambridge University Press.

## CHAPTER 2 TOPICS

**Which Media Are Best for Learning?**

**Four Components of Learning**

- What Are Communication Modes?
- What Are Instructional Methods?
- Instructional Architectures: The DNA of Learning

**Three Views of Learning**

- The Absorption View
- The Behavioral View
- The Constructive View

**Four Instructional Architectures**

- Receptive Architectures
- Directive Architectures
- Guided Discovery Architectures
- Exploratory Architectures
- Architectural Blends

# 2

# Four Ingredients of Instruction

*Overwhelming evidence has shown that learning in an online environment can be as effective as that in traditional classrooms*

TALLENT-RUNNELS, THOMAS, LAN, COOPER, AHREN, SHAW, AND LIU, 2006

**IN THIS CHAPTER** I introduce the four key components of all learning environments: modes, methods, media, and architectures. Communication modes include text, audio, and graphics. Instructional methods are techniques such as examples and practice exercises used to deliver content and promote learning. Media are the devices that deliver training and include instructors, books, and various types of digital technology. Finally, lessons are framed on the basis of four design architectures: receptive, directive, guided discovery, and exploratory. Each architecture reflects different views of learning and has appropriate applications depending on the learners and the training goals.

Over fifty years of media comparison research concludes that it is instructional modes, methods, and architectures – not media- that most directly influence learning. However the "best" modes, methods and architectures will depend on your learner's background knowledge as well as your learning outcome goals.

## Which Media Are Best for Learning?

Which is better for learning: a face-to-face classroom, a textbook, self-study e-learning, or an online virtual classroom? For many years, we've wondered about the effectiveness of different instructional delivery *media*. With each new technology wave, enthusiasts argue that the latest is the best! What research do we have about media effectiveness?

Hall and Cushing conducted one of the first media comparison studies for the U.S. Army in 1947. They believed that film would teach better than classroom instruction (Hall & Cushing, 1947). They presented a lesson on how to calibrate a micrometer to separate groups via film, classroom instructor, or self-study using a workbook. The words and pictures in all three lesson versions were identical except that the film used moving pictures. In other words, the script used in the movie used the same words that the instructor used in the classroom. And the visuals used in the workbook were the same as in the movie, except they were still visuals. All students were tested at the end of the lesson. The results? No differences in learning!

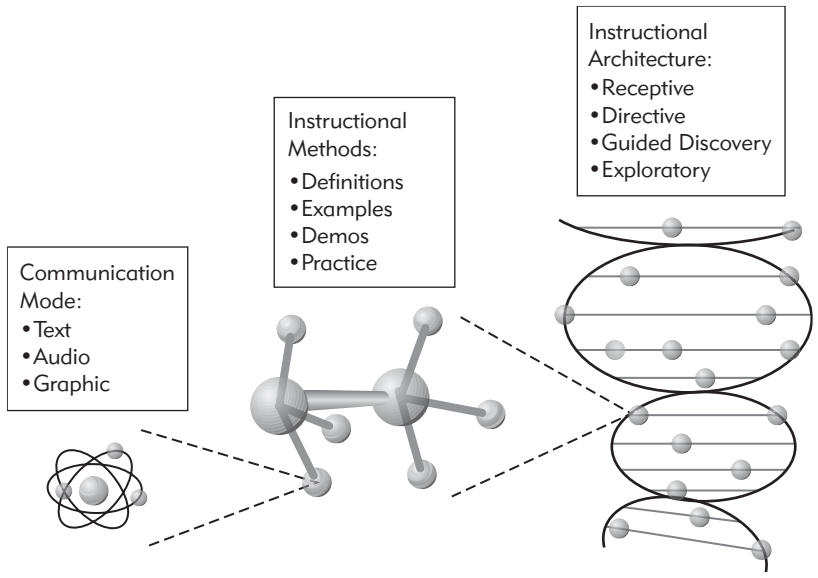
After many years of media comparison research with outcomes similar to the Army study, we realize that the media per se do not determine instructional effectiveness. Bernard, Abrami, Lou, Borokhovski, Wade, Wozney, Wallet, Fishet, & Huang (2004) conducted a meta-analysis that incorporated over 350 experimental comparisons of learning from a face to face classroom with learning from some form of electronic distance learning. They found that, most of the effect sizes fell close to 0, indicating no practical differences in learning. However, in some situations the classroom version resulted in much better learning than the digital version and vice versa. All of us have attended traditional classroom events that were not effective. The same holds true for digitized lessons. Tallent-Runnels, Thomas, Lan, Cooper, Ahren, Shaw, and Liu (2006) conclude: "Learning in an online environment

can be as effective as that in traditional classrooms. Second, students' learning in the online environment is affected by the quality of online instruction. Not surprisingly, students in well-designed and well-implemented online courses learned significantly more, and more effectively than those in online courses where teaching and learning activities were not carefully planned" (p. 116).

## Four Components of Learning

What influences learning is not the delivery medium but the way the facilities of the medium are used to promote learning. Regardless of medium, learning effectiveness depends on the best use of the other three components: *modes*, *methods,* and *architectures*. These are the active ingredients of any instructional environment. As a former science teacher, I can't resist a chemistry metaphor. In Figure 2.1 I illustrate the modes, methods, and architectures with atoms, molecules and DNA.

**Figure 2.1. A Chemistry Analogy for Modes, Methods, and Architectures**
From Clark and Kwinn, 2006



## What Are Communication Modes?

No matter what delivery media you use in your training, you will communicate content and training techniques through some combination of text, audio, and graphics—still and animated. I imagine these as the atoms that are the basic building blocks of your lessons. As you present content and prepare practice opportunities, you will use words and visuals as your communication vehicles. As you will see throughout the book, we have quite a bit of research on how best to use text, audio, and visuals to promote learning.

Your selection of communication modes will depend on your delivery medium and on research on how best to use audio and visual elements to teach new knowledge and skills. Some media are limited in the modes they can handle. Books like this one, for example, are generally limited to text and a few still graphics. Computer lessons, however, can include text, audio, and both still and animated visuals. When using media that can handle multiple modes, apply the research I will review in Chapters 6 and 9 to guide your decisions.

## What Are Instructional Methods?

Learning requires an active processing of lesson content so that it becomes integrated with existing knowledge already in memory. Instructional methods are techniques such as examples and practice exercises that lead to learning. Well-crafted methods support the psychological processes that mediate the transformation of lesson content into internal knowledge and skills stored in memory. For example, a useful practice exercise will guide the learner to rehearse new information in ways that will encourage its encoding into memory. Use instructional methods that support the learners' mental processes and avoid methods that disrupt learning processes. Most of the chapters in this book will show

you methods to support these processes. I picture methods as the molecules of instruction—the building blocks that deliver your content and promote its active integration into memory.

### Instructional Architectures: The DNA of Learning

In my chemistry metaphor, I represent architectures as the DNA of instruction—the design framework that will orchestrate how the modes and methods will be used and combined in any learning event. When instructional professionals construct a training or educational program, they usually will begin with a blueprint that illustrates the content and activities to be included in the final event. For example, they may write an outline, learning objectives, or flow charts. This planning phase is referred to as *design* and it is during this process that the instructional architecture and instructional methods are specified. Later, the blueprint is transformed into training materials in the form of workbooks, slides, or online screens. This stage is referred to as *development* and it is here that the architectures and methods are implemented. Let's take a more detailed look at three learning assumptions and four architectures that reflect those assumptions.

## Three Views of Learning

Three views of learning reflect different assumptions that lead to different instructional approaches. The three views are: *absorption*, *behavioral,* and *constructive*.

### The Absorption View

From lectures to reading assignments, I believe that the majority of learning environments reflect an absorption view of learning. In this view, learning is about assimilating information and instruction is about providing information to learners. Mayer

(2001) calls this perspective a "*transmission*" view of teaching. Why are transmission-type courses so common? I believe it's because: (1) they are the fastest and easiest to prepare, (2) they represent a familiar teaching environment that many have adopted from their educational experiences, and (3). many stakeholders and some instructional professionals lack an understanding of the active nature of learning.

## The Behavioral View

A popular form of training in the mid part of the 20th Century was programmed instruction. Although the early forms of programmed learning presented in books have virtually disappeared, modern versions are prevalent in many digital training environments. Programmed instruction and its modern counterparts are designed on the assumption that learning is based on the acquisition of mental associations. In this view, learning is about making correct responses to questions, and instruction is about providing small chunks of information followed by questions and corrective feedback. In the course of making many small correct responses, learners build large chains of new knowledge.

## The Constructive View

In the last part of the 20th Century, learning was again reconceptualized. In a constructive view, emphasis is on the active processes learners use to build new knowledge. This construction requires an integration of new incoming information from the environment with existing knowledge in memory. In the constructive view, learning is about active construction of new knowledge by engaging with diverse sources including instructors, training materials, and peers, and instruction is about setting up learning environments that mediate constructive activities.

Although the active construction of knowledge is commonly accepted today as the mechanism for learning, that construction