CHAPTER OUTLINE

1

e-Learning

PROMISE AND PITFALLS

WHAT'S NEW IN THIS CHAPTER?

IN THIS CHAPTER we define e-learning as training delivered on a computer (including CD-ROM, Internet, or intranet) that is designed to support individual learning or organizational performance goals. We include e-courses developed primarily to provide information (inform courses), as well as those designed to build specific job-related skills (perform courses).

Since our first edition, synchronous forms of e-learning, also called virtual classrooms, have assumed a large and growing share of online training courseware. Therefore we expanded this edition to illustrate how our guidelines apply to virtual classrooms.

Instructional methods that support rather than defeat human learning processes are an essential ingredient of all good e-learning courseware. The best methods will depend on the goals of the training (for example, to inform

or to perform); the learners' related skills; and various environmental factors, including technological, cultural, and pragmatic constraints. We distinguish among three design architectures for e-learning: receptive, directive, and guided discovery.

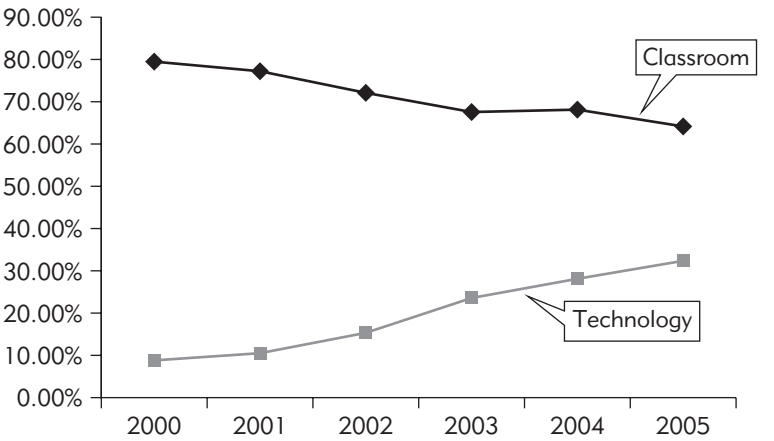
The e-Learning Bandwagon

In our first edition, we asked whether the proliferating cyber courses of the late 20th Century were harbingers of a new age in learning or just another overstatement of the expectations that had surrounded nearly everything associated with the dot com bubble. The trends in delivery media for workforce learning in the last six years, shown in Figure 1.1, are pretty convincing. **e**-Learning is here to stay! In our first edition, we reported that in the year 2001, approximately 11 percent of all training was delivered via computer (including the Internet, intranets, and CD-ROM). As we write the second edition at the end of 2006, we see that figure has risen to 29 percent (Industry Report, 2006). That means close to one-third of all workforce learning is delivered electronically!

Part of the increase in e-learning reflects the emergence of a whole new form of electronic delivery, practically unheard of when we wrote the first

Figure 1.1. Percentage Training Hours Delivered by Classroom and Technology.

Based on data from Sugrue and Rivera, 2005.



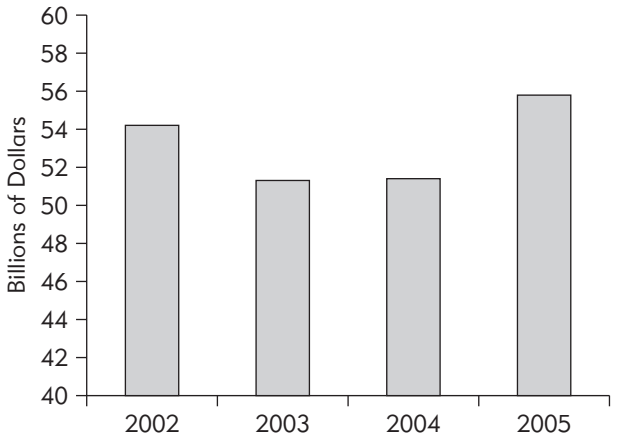
edition: the virtual classroom. In 2003, the first data on use of virtual classrooms reported 3 percent of all training hours were delivered via synchronous e-learning (Sugrue & Rivera, 2005). In just a few short years, that number has grown to 15 percent! The lure of travel savings and rapid deployment of training has made the virtual classroom a popular alternative to asynchronous e-learning. However, it remains to be seen how the mix of synchronous and asynchronous forms of e-learning will balance out. For example, in 2006, self-study asynchronous forms of e-learning rose from 7 percent in 2005 to 15 percent of all delivery hours (Industry Report, 2006). What is certain is that e-learning of all types is growing as a dominant delivery medium for workforce learning.

e-Learning is used across the board to support diverse organizational training goals. The training requirements that make heaviest use of e-learning include profession or industry-specific training at 74 percent, compliance training at 68 percent, and desktop application training at 66 percent (Industry Report, 2006). Some training areas relying less on online learning include sales, customer service, executive development, and interpersonal skills training. These training goals have interpersonal skills as a common element that is perceived to benefit most from face-to-face classroom instruction.

Annual investments in training are high and growing. As you can see in Figure 1.2, over the past four years between fifty and sixty billion dollars

Figure 1.2. Dollars Invested in U.S. Workforce Learning.

Based on Industry Report, 2006.



were spent on training workers in corporate and governmental organizations in the United States (Industry Report, 2006). And these figures don't include the most expensive element of training, the salary time and lost opportunity costs of those taking training. Organizations are turning to e-learning to save training time and travel costs associated with traditional face-to-face learning. However, cost savings are only an illusion when e-learning does not effectively build knowledge and skills linked to desired job outcomes. Does e-learning offer a potential opportunity to cost-effectively build the skills required for the knowledge-based economy of this century? Part of the answer will depend on the quality of the instruction embedded in the e-learning products you are designing, building, or selecting today.

What Is e-Learning?

We define e-learning as instruction delivered on a computer by way of CD-ROM, Internet, or intranet with the following features:

- Includes content relevant to the learning objective
- Uses instructional methods such as examples and practice to help learning
- Uses media elements such as words and pictures to deliver the content and methods
- May be instructor-led (synchronous e-learning) or designed for self-paced individual study (asynchronous e-learning)
- Builds new knowledge and skills linked to individual learning goals or to improved organizational performance

As you can see, this definition has several elements concerning the what, how, and why of e-learning.

What. e-Learning courses include both content (that is, information) and instructional methods (that is, techniques) that help people learn the content.

How. e-Learning courses are delivered via computer using words in the form of spoken or printed text and pictures, such as illustrations, photos, animation, or video. Some forms of e-learning (asynchronous) are designed for individual self-study. New e-learning formats called virtual classrooms or synchronous e-learning are designed for real-time instructor-led training. Both formats may support asynchronous collaboration with others through tools such as wikis, discussion boards, and email.

Why. e-Learning courses are intended to help learners reach personal learning objectives or perform their jobs in ways that improve the bottom-line goals of the organization.

In short, the "e" in e-learning refers to the "how": the course is digitized so it can be stored in electronic form. The "learning" in e-learning refers to the "what": the course includes content and ways to help people learn it; and the "why" refers to the purpose: to help individuals achieve educational goals or to help organizations build skills related to improved job performance.

Our definition indicates that the goal of e-learning is to build job-transferable knowledge and skills linked to organizational performance or to help individuals achieve personal learning goals. Although the guidelines we present throughout the book do apply to lessons designed for educational or general interest learning goals, our emphasis is on instructional programs that are built or purchased for workforce learning.

Self-Study Versus Virtual Classroom e-Learning

Our first edition focused exclusively on self-study forms of e-learning, also called asynchronous e-learning. Figure 1.3 shows a screen shot from an asynchronous course on How to Construct Formulas in Excel. Asynchronous courses are designed to be taken by individuals at their own time and pace. In contrast, Figure 1.4 shows a screen shot from a virtual classroom course on How to Construct Formulas in Excel.

Take a close look at Figure 1.4 if you are new to the virtual classroom. From WebEx to Live Meetings, most virtual classroom tools incorporate similar functions, although the screen interfaces may differ. Figure 1.4 shows a screen capture from Elluminate virtual classroom software. The largest

Figure 1.3. A Screen Capture from an Asynchronous Excel Lesson.
From Clark, Nguyen, and Sweller, 2006.

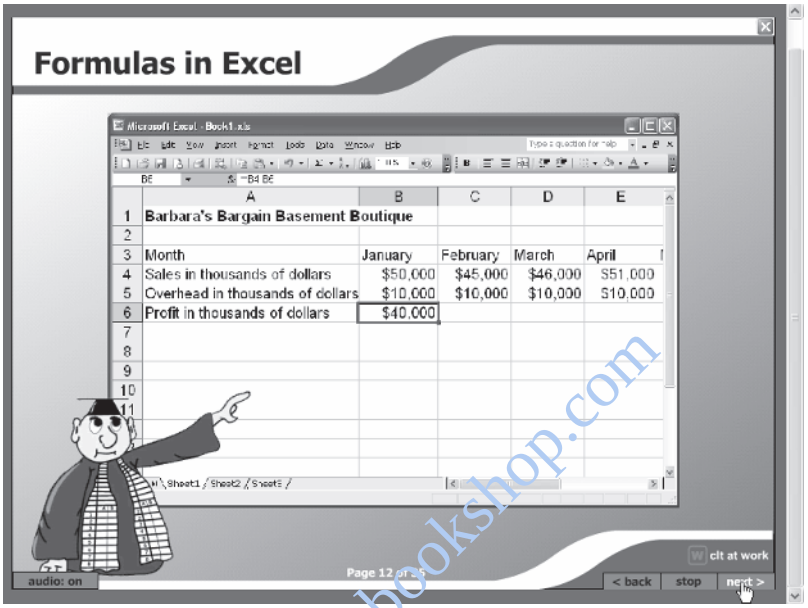
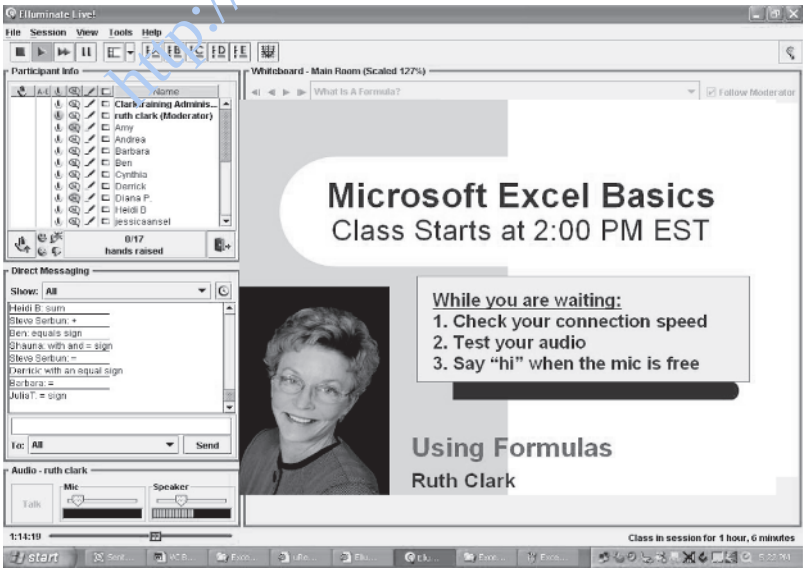


Figure 1.4. A Screen Capture from a Virtual Classroom Excel Lesson.



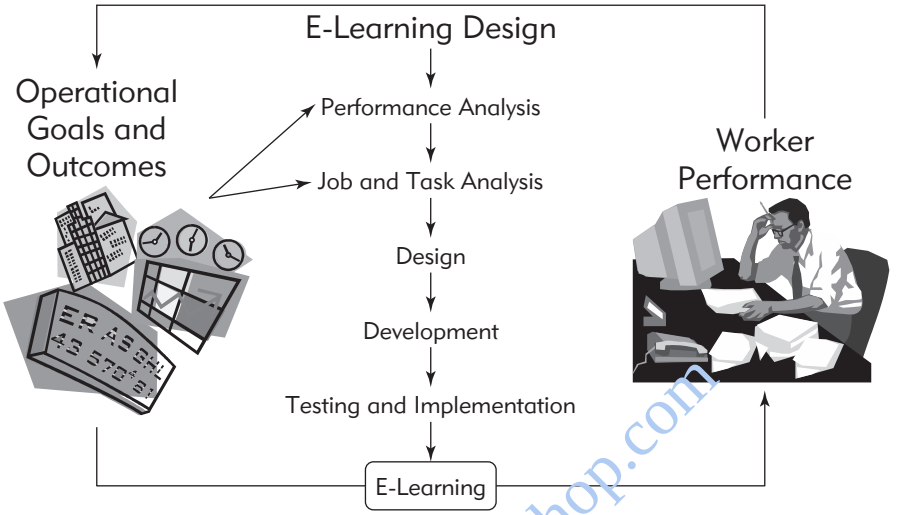
portion of the screen is devoted to the whiteboard on which the instructor can project slides. To the upper left of the whiteboard is the participant window showing the names of everyone attending the session. Below the participant window is a chat box in which everyone can type text messages. At the bottom left is an audio control box used by instructors or participants when they want to speak. The instructor and class participants wear headsets with microphones, allowing them to speak and to hear what others are saying.

Clark and Kwinn (2007) characterize virtual classroom technology as a hybrid tool, one that incorporates some features of both asynchronous e-learning and instructor-led face-to-face classrooms. Like asynchronous e-learning, the virtual classroom relies on screen real estate to communicate content and instructional methods. Also like asynchronous e-learning, virtual classrooms benefit from frequent learner interactions to sustain attention and promote learning. Like face-to-face classrooms, virtual classrooms are instructor-led. Therefore, presentation rates are not controlled by learners as in most asynchronous e-learning. In addition, opportunities for social presence are higher in the virtual classroom than in asynchronous e-learning, since virtual classrooms are typically designed for group learning, while asynchronous e-learning is typically designed for individual self-study.

e-Learning Development Process

We saw in Figure 1.2 that training investments in business and industry are nearing $60 billion! To get a return on investment, all training initiatives, including e-learning, must improve job performances that lead to achievement of organizational operational goals. Operational goals are bottom-line indicators of organizational success, such as increase in market share, decrease in product flaws or errors, increase in customer satisfaction, or fewer accidents, to name but a few. Unless some analysis and planning accompanies any e-learning project, any return on investment is likely to be by chance alone. In Figure 1.5 we summarize a systematic process for e-learning projects. Since there are many good books on e-learning development, we provide only a brief overview here.

Figure 1.5. Alignment of e-Learning with Operational Outcomes.



Performance Analysis

All e-learning projects should begin with a performance analysis to determine that (a) training will help realize important organizational goals by filling a gap in worker knowledge and skills related to operational outcomes and (b) e-learning is the best delivery solution. Often training is requested to solve organizational problems that are not caused by a lack of knowledge and skills. In these cases, the root cause(s) of the problems should be defined and an expensive solution like training should be avoided (Clark & Nguyen, 2007). If training is needed, the analysis should consider the tradeoffs among various delivery alternatives such as classroom instruction, job coaching, working aids, asynchronous and synchronous e-learning, or a blend of several of these.

Defining e-Learning Content

Following the performance analysis, a team begins by defining the content needed to perform the job or achieve the educational objective. In order for training to pay off with improved job performance, an e-learning development effort must start by defining the job tasks associated with operational

goals and the knowledge needed to perform these tasks. The e-learning development team observes and interviews people who are expert at a job to define the job skills and knowledge. For courseware developed for broader educational purposes, rather than a job analysis, the development team conducts a content analysis to define the major topics and related subtopics to be included.

Based on either the job or content analysis, the team categorizes the content of an e-lesson into facts, concepts, processes, procedures, and strategic guidelines. Table 1.1 defines these content types, which have been described in detail by Ruth Clark (2007). For example, the screen in Figure 1.3 from asynchronous e-learning is designed to teach use of formulas with Excel. The content being illustrated is a procedure: how to enter a formula into the spreadsheet. In this segment of the lesson, a learning agent shown in the lower left is describing in audio an animated demonstration of the steps to construct and enter a formula to calculate January profit in the spreadsheet.

At the completion of the job or content analysis, the design team will create a course blueprint that includes lesson outlines and learning objectives. The blueprint will serve as a model for the course development effort to follow.

Table 1.1. Five Types of Content in e-Learning.

Content Type	*Definition*	*Example*
Fact	Specific and unique data or instance	Operator symbols for Excel formulas
Concept	A category that includes multiple examples	Excel formulas
Process	A flow of events or activities	How spreadsheets work
Procedure	Task performed with step-by-step actions	How to enter a formula into the spreadsheet
Strategic Principles	Task performed by adapting guidelines	How to do a financial projection with a spreadsheet

Defining the Instructional Methods and Media Elements

Instructional methods support the learning of the content. Instructional methods include techniques such as examples, practice exercises, and feedback. In our example screen shown in Figure 1.3, the main instructional method is a demonstration. We define media elements as the audio and visual techniques used to present words and illustrations. Media elements include text, narration, music, still graphics, photographs, and animation. In the Excel course, audio narration presents the words of the learning agent and an animated graphic illustrates the steps of the demonstration. One of our fundamental tenets is that, to be effective, instructional methods and the media elements that deliver them must guide learners to effectively process and assimilate new knowledge and skills.

How Delivery Platforms and Software Shape Instruction

e-Learning, as we use the term, includes training delivered via CD-ROM, intranets, and the Internet. In our first edition, we reported that approximately 40 percent of computer-delivered training used CD-ROM, while 22 percent used the Internet and 30 percent used intranets (Galvin, 2001). In the intervening five years, upgrades in organizations' networks in combination with the advantages of networked delivery make Inter- and intranet solutions the predominant distribution choice at close to 90 percent of all e-learning (Sugrue & Rivera, 2005).

Your choice of delivery platform and software can influence which instructional methods and media elements can be included in the courseware. For example, limitations in bandwidth, no sound cards, or lack of headsets may limit the use of some media elements such as audio and video. Most of the major virtual classroom tools support audio and brief video clips. As we will see in later chapters, lack of audio is a constraint that will negatively impact the instructional quality of your e-learning courseware. In contrast, simple graphics are often as useful or better for learning than more complex visuals such as animations and video.

Two Types of e-Learning Goals: Inform and Perform

As summarized in Table 1.2, the guidelines in this book apply to e-learning that is designed to inform as well as e-learning that is designed to improve specific job performance. We classify lessons that are designed primarily to build awareness or provide information as *inform programs,* also known as briefings. A new employee orientation that reviews the company history and describes the company organization or a product knowledge update are examples of topics that are often presented as inform programs. The information presented is job relevant, but there are no specific expectations of new skills to be acquired. The primary goal of these programs is to transmit information. In contrast, we classify programs designed to build specific skills as *perform programs.* Some typical examples of perform e-learning are lessons on software use, designing a database, or evaluating a bank loan applicant. Many e-courses contain both inform and perform learning objectives, while some are designed for inform only or perform only.

Table 1.2. Inform and Perform e-Learning Goals.

Goal	*Definition*	*Example*
Inform	Lessons that communicate information	• Company history • New product features
Perform Procedure	Lessons that build procedural skills (also called near transfer)	• How to log on • How to complete an expense report
Perform Principle	Lessons that build strategic skills (also called far transfer)	• How to close a sale • How to analyze a loan

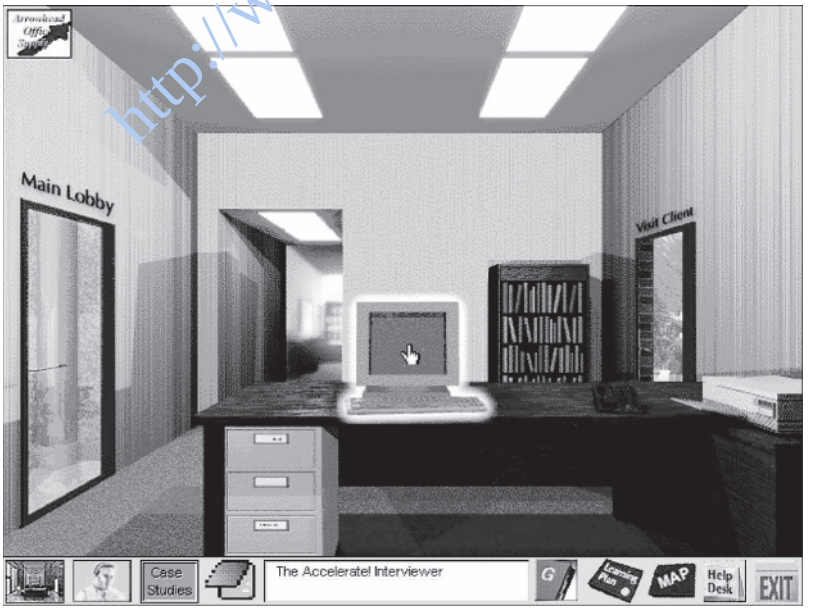
Near Versus Far Transfer Perform Goals

We distinguish between two types of perform goals: (1) procedural, also known as near transfer, and (2) principle-based or strategic, also known as far transfer. Procedural lessons such as the Excel examples in Figures 1.3 and 1.4

are designed to teach step-by-step tasks, which are performed more or less the same way each time. Most computer-skills training falls into this category. This type of training is called near transfer because the steps learned in the training are identical or very similar to the steps required in the job environment. Thus the transfer from training to application is near.

Principle-based lessons, also called far transfer, are designed to teach task strategies that do not have one correct approach or outcome. Thus the situations presented in the training may not be exactly the same as the situations that occur on the job. These tasks require the worker to adapt strategies to various job situations. Typically, some element of problem solving is involved. The worker always has to use judgment in performing these tasks, since there is no one right approach for all situations. Far-transfer lessons include just about all soft-skill training, supervision and management courses, and sales skills. Figure 1.6 illustrates a screen from a principle-based course on analyzing a commercial loan. The lesson begins with an assignment to research and recommend a new bank client who has applied for a commercial loan.

Figure 1.6. Far-Transfer Course on Loan Analysis.
With permission from Moody's Investment Service.



The learner has access to data from the various office resources shown in the interface, including the computer, fax machine, telephone, and books. Since the worker will always have to use judgment in applying training guidelines to the job, we say that the transfer from training to job is far.

Is e-Learning Better? Media Comparison Research

Contrary to the impression left by recent reports on the use and benefits of e-learning, much of what we are seeing under the e-learning label is not new. Training delivered on a computer, known as computer-based training or CBT, has been around for more than thirty years. Early examples delivered over mainframe computers were primarily text on a screen with interspersed questions—electronic versions of behaviorist psychologist B.F. Skinner's teaching machine. The computer program evaluated answers to the multiple-choice questions, and prewritten feedback was matched to the learner responses. The main application of these early e-lessons was training in the use of mainframe computer systems. As technology has evolved, acquiring greater capability to deliver true multimedia, the courseware has become more elaborate in terms of realistic graphics, audio, color, animation, and complex simulations. But as you will see, greater complexity of media does not necessarily ensure more learning.

Each new wave of instructional delivery technology (starting with film in the 1920s) spawned optimistic predictions of massive improvements in learning. For example, in 1947 the U.S. Army conducted one of the first media comparisons with the hypothesis that film teaches better than classroom instructors (see box for details). Yet after fifty years of research attempting to demonstrate that the latest media are better, the outcomes have not supported the media superiority view.

THE FIRST MEDIA COMPARISON STUDY

In 1947 the U.S. Army conducted research to demonstrate that instruction delivered by film resulted in better learning outcomes than traditional classroom or paper-based versions. Three versions of a lesson on how to read a micrometer were developed.

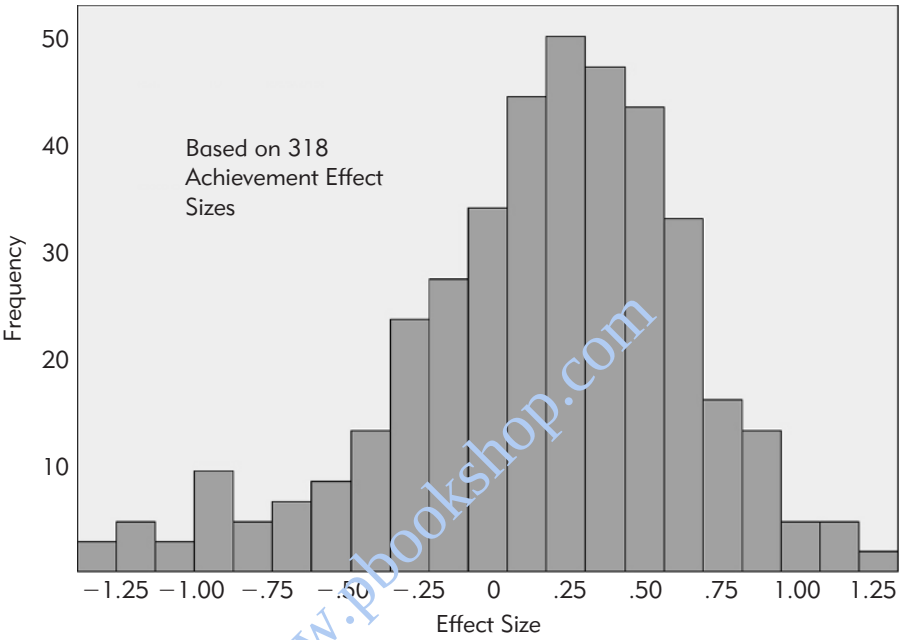
The film version included a narrated demonstration of how to read the micrometer. A second version was taught in a classroom. The instructor used the same script and included a demonstration using actual equipment, along with still slide pictures. A third version was a self-study paper lesson in which the text used the same words as the film, along with pictures with arrows to indicate movement. Learners were randomly assigned to a version and after the training session they were tested to see whether they could read the micrometer. Which group learned more? There were no differences in learning among the three groups (Hall & Cushing, 1947).

With few exceptions, the hundreds of media comparison studies have shown no differences in learning (Clark, 1994; Dillon & Gabbard, 1998). Since our first edition, there have been two new major reports synthesizing research on the effectiveness of online learning. A report by Bernard et al. (2004) integrating research studies that compared outcomes from electronic distance education to outcomes from traditional classroom instruction yielded the achievement effect sizes shown in Figure 1.7. (See Chapter 2 for information on effect sizes.) As you can see, the majority of effect sizes are close to zero, indicating no practical differences in learning between face-to-face and electronic distance learning. However, the bars at either end of the histogram show that some distance learning courses were much more effective than classroom courses and vice versa. A review of online learning by Tallent-Runnels et al. (2006) concurs. The research team concludes that:

> "Overwhelming evidence has shown that 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 and where the delivery and accessibility were impeded by technology problems." (p. 116)

Figure 1.7. Electronic Distance Learning vs. Face-to-Face Instruction: Histogram of Effects.

Adapted from Bernard et al., 2004.



From all the media comparison research, we have learned that it's not the delivery medium, but rather the instructional methods that cause learning. When the instructional methods remain essentially the same, so does the learning, no matter how the instruction is delivered. When a course uses effective instructional methods, learning will be better, no matter what delivery medium is used.

Nevertheless, as we will discuss in the following sections, each medium offers unique opportunities to deliver instructional methods that other media cannot. It's a common error to design each new medium to mirror older ones. For example, some e-lessons appear to be books transferred to a screen. To exploit each medium fully, the unique capabilities of the technology should be used in ways that effectively support human learning.

What Makes e-Learning Unique?

Can we conclude from the media comparison research that all media are equivalent? Not quite. Not all media can deliver all instructional methods. For example, the capability of a paper document to deliver audio or animation is quite limited. Four potentially valuable instructional methods unique to e-learning are (1) practice with automated tailored feedback, (2) integration of collaboration with self-study, (3) dynamic adjustment of instruction based on learning, and (4) use of simulation and games.

Practice with Feedback

In the Excel courses illustrated in Figures 1.3 and 1.4, the learner has opportunities to practice the steps to input a formula into the spreadsheet. The asynchronous course includes a simulation that directs learners to construct and enter the correct formula to achieve an assigned calculation. If an incorrect formula is used, the program gives automated feedback telling the learner his or her answer is wrong, providing a hint and asking the learner to try again. Prior to this hands-on practice, the learners have seen an animated, narrated demonstration of the steps required to input a formula. Similar instructional methods are used in the virtual classroom version. Here, the instructor provides a demonstration by sharing an Excel spreadsheet from the desktop. Following the demonstration, the instructor assigns learners calculations using the shared application. What is unique in asynchronous e-learning is that the learner's actions taken in the simulation are evaluated by a program that responds with hints or feedback supporting immediate correction of errors. In synchronous e-learning, the instructor reviews student answers and gives feedback, as in a traditional face-to-face classroom. Chapter 11 in this book describes what to look for in effectively designed practice in e-learning.

Social Software and Collaboration

The first CBT lessons were for solo learning. There was little or no interaction with others. But the power of the Internet erases that limitation. In the virtual classroom participants communicate in real time through text chat or

audio. In both virtual classrooms and asynchronous e-learning, learners can collaborate at independent times by email and discussion boards. With the emergence of synchronous e-learning as well as social software such as wikis and blogs, we anticipate a growing trend in leveraging collaborative tools for learning.

We do have evidence that, under the right conditions, learning and working together can result in better outcomes than learning and working by oneself. Unfortunately, we do not yet have sufficient research to specify all of the conditions required to optimize collaborative learning facilities. Chapter 13 reviews the research we do have and provides limited guidelines for ways to harness the collaborative facilities of the Internet for learning purposes.

Tailored Instruction

e-Learning is the only technology-based delivery vehicle that can make ongoing dynamic adjustments to the instructional path based on learners' responses. For example, if the learner makes errors on a practice problem of intermediate complexity, the program can offer either an easier problem or a similar problem accompanied by increased instructional help. This tailoring of instruction based on learning progress is called *adaptive instruction.* Adaptive instruction can be implemented in asynchronous e-learning and is most beneficial when training time and costs can be saved by tailoring lessons to individual requirements.

Simulations and Games

In Figure 1.6 we introduce a course that is based on a simulated case study for learning an effective process to analyze and recommend funding for a commercial loan applicant. After receiving a new commercial loan to evaluate, the learners can access the various objects in the office such as the fax, computer, or telephone. They can also visit the loan applicant to conduct an interview. Once the learners have collected sufficient data, they indicate whether the loan is approved or denied. Thus, a new loan agent can experience in a short time a number of real-world loan situations in the safety of a controlled environment. The bank loan course illustrates the power of

simulation in which realistic job problems are compressed into a short timeframe. The motivational appeal of online games has prompted great interest in constructing learning games based on software simulations. However, not all games are equally effective. In Chapter 15, we summarize evidence and guidelines for use of simulations and games in e-learning.

e-Learning: The Pitfalls

Despite these impressive capabilities of computer-delivered instruction, we see two common barriers to the realization of the potential of online learning. These are: (1) losing sight of the job, leading to transfer failure, and (2) media abuse, leading to over or under use of technology in ways that defeat learning.

Pitfall One: Losing Sight of the Job

To design powerful learning environments whose lessons both transfer to the workplace and improve the performance of the organization is not easy, no matter whether planned for classroom or multimedia delivery. To teach higher-order problem-solving skills like the ones illustrated in the bank loan program (Figure 1.6), the designer must first define what those skills are. Research on expertise shows that these skills are job-specific. In other words, the knowledge base underlying a physician is different from one that makes a programmer. There is no one set of skills that support expertise across the diverse contemporary workforce.

Whether planning for near- or far-transfer learning, a detailed job and task analysis is a prerequisite and a labor-intensive process. e-Lessons that bypass the job analysis process run the risk of presenting knowledge and techniques out of context. As you will see in Chapters 10 and 11, lack of job context risks transfer failure. In the end, teaching knowledge and skills that do not result in job performance changes will not yield a return on investment.

Pitfall Two: Media Abuse

Sometimes "technophiles" use all of the technology features available to them and in so doing overload learners' processing capabilities. For example, they may decide to include audio in the form of music and narration,

on-screen text, and animated visuals in an online simulation. As you will read in Chapter 2, humans have limited capacity to absorb information and over-enthusiastic use of software features can depress learning. In contrast, "technostics" tend to ignore media capabilities. For example, books may be transferred to screens, resulting in page turner e-learning. Alternatively, face-to-face classrooms may be converted to virtual classrooms with no modifications to take advantages of the features of the technology. Unlike face-to-face events, however, in e-learning classes, the learner can easily minimize the application or exit the session to engage in more productive or motivating activities. In this book we advocate a balance between the technophile and technostic approaches in which you apply research evidence on how to use technology features in ways that promote learning.

What Is Good e-Courseware?

A central question for our book is, "What does good courseware look like?" Throughout the book we recommend specific features to look for or to design into your e-learning. However, you will need to adapt our recommendations based on four main considerations—the goal of your training, the prior knowledge of your learners, the environment in which you will deploy your training, and the instructional architectures you use in your e-learning lessons.

Training Goals

The goals or intended outcomes of your e-learning will influence which guidelines are most appropriate for you to consider. Earlier in this chapter we made distinctions among three types of training designed to inform the student, to perform procedures, and to perform strategic tasks. For inform e-lessons, apply the guidelines in Chapters 3 through 9 regarding the best use of media elements, including visuals, narration, and text to present information. To train for procedural skills, apply these guidelines and add to them relevant suggestions regarding the design of examples and practice sessions in Chapters 10 and 11. If, however, your goal is to develop strategic or far-transfer skills, you will want to apply the guidelines from all the chapters, including Chapter 14 on teaching problem-solving skills and Chapter 15 on games and simulations.

Learner Differences

In addition to selecting or designing courseware specific to the type of outcome desired, lessons should include instructional methods appropriate to the learner's characteristics. While various individual differences such as learning styles have received the attention of the training community, research has proven that the learner's prior knowledge of the course content exerts the most influence on learning. Learners with little prior knowledge will benefit from different instructional methods than will learners who are relatively experienced.

For the most part, the guidelines we provide in this book are based on research conducted with adult learners who were new to the course content. If your target audience has greater background knowledge in the course content, some of these guidelines may be less applicable. For example, Chapter 5 suggests that if you explain graphics with audio narration rather than text, you reduce the mental workload required of the learner and thereby increase learning. However, if your learners are experienced regarding the skills you are teaching, overload is not as likely and they will probably learn effectively from text or audio.

Environment

A third factor that affects e-learning is the environment—including such issues as technical constraints of the delivery platform, network, and software, cultural factors in institutions such as the acceptance of and routine familiarity with technology, and pragmatic constraints related to budget, time, and management expectations. In this book we focus on what works best from a psychological perspective, but we recognize that you will have to adapt our guidelines to your own unique set of environmental factors.

e-Learning Architectures

Although all e-learning is delivered on a computer, different courses reflect different assumptions of learning, which we introduce here and describe in detail in Chapter 2. During the past one hundred years, three views of learning have evolved, and you will see each view is reflected in courses

available today. The three views are reflected in the design architecture you select for your training (Clark, 2003). The three architectures and the learning assumptions on which they are based, summarized in Table 1.3, are *receptive* based on an *information acquisition* view, *directive* based on a *response strengthening* view, and *guided discovery* based on a *knowledge construction* view.

Table 1.3. Three e-Learning Architectures.

Architecture	*View*	*Inter-Activity*	*Used for*
Receptive	Information acquisition	Low	Inform training goals such as new hire orientation
Directive	Response strengthening	Medium	Perform procedure training goals such as software skills
Guided Discovery	Knowledge construction	High	Perform strategic training goals such as problem solving

Interactivity in e-Learning

The interactivity of the lessons (from low to high) is one important feature that distinguishes lessons built using the various architectures. Receptive types of e-learning fall at the lower end of the interactivity scale, as they incorporate little or no opportunity for explicit learner responses. Receptive lessons are used most frequently for inform training goals. For learning to occur, it is up to the viewers of a receptive lesson to initiate mental processing of the information themselves, since no external processing opportunities are included. In the mid-range of interactivity are directive e-learning programs. Directive lessons follow a sequence of "explanation-example-question-feedback." These architectures, commonly designed for perform procedure training goals, incorporate highly structured practice opportunities designed to guide learning in a step-by-step manner. The Excel lessons shown in

Figures 1.3 and 1.4 apply the directive architecture. Guided discovery forms of e-learning, including simulations and games, fall in the high interactivity range of the continuum. For example, Figure 1.6 shows the interface for a guided discovery course in which the learner is constantly engaged by clicking on various on-screen objects that provide data or activities related to commercial bank loan analysis.

Learning is possible from any of these three architectures if learners engage in active knowledge construction. In receptive courses, it will be up to the learner to actively process the content provided. In directive and guided discovery architectures, knowledge construction is overtly promoted by the interactions built into the lessons. In the next chapter we describe more about the psychological processes needed for learning and how instructional methods in these architectures can support or defeat those processes.

Learning in e-Learning

The challenge in e-learning, as in any learning program, is to build lessons in ways that are compatible with human learning processes. To be effective, instructional methods must support these processes. That is, they must foster the psychological events necessary for learning. While the computer technology for delivery of e-learning is upgraded weekly, the human side of the equation—the neurological infrastructure underlying the learning process—is very old and designed for change only over evolutionary time spans. In fact, technology can easily deliver more sensory data than the human nervous system can process. To the extent that audio and visual elements in a lesson interfere with human cognition, learning will be depressed.

We know a lot about how learning occurs. Over the past twenty years, hundreds of research studies on cognitive learning processes and methods that support them have been published. Much of this new knowledge remains inaccessible to those who are producing or evaluating online learning because it has been distributed primarily within the research community. This book fills the gap by summarizing research-based answers to questions that multimedia producers and consumers ask about what to look for in effective e-learning.

COMING NEXT

Since instructional methods must support the psychological processes of learning, the next chapter summarizes those processes. We include an overview of our current understanding of the human learning system and the processes involved in building knowledge and skills in learners. We provide several examples of how instructional methods used in e-lessons support cognitive processes. In addition, we present some guidelines to help you understand and evaluate research evidence presented throughout the book.

Suggested Readings

Clark, R.C. (2000). Four architectures of learning. *Performance Improvement, 39*(10), 31–37.

Clark, R.C., & Kwinn, A. (2007). *The new virtual classroom: Evidence-based guidelines for synchronous e-learning*. San Francisco, CA: Pfeiffer.

Mayer, R.E. (Ed.). (2005). *The Cambridge handbook of multimedia learning*. New York: Cambridge University Press.