CHAPTER OUTLINE

1

e-Learning

PROMISE AND PITFALLS

CHAPTER SUMMARY

IN THIS CHAPTER we define e-learning as instruction delivered on a digital device that is intended to support learning. In e-learning the delivery hardware can range from desktop or laptop computers to tablets or smart phones, but the instructional goal is to support individual learning or organizational performance goals. Our scope includes e-learning designed for self-study available upon demand (asynchronous e-learning) as well as instructor-led e-learning presented at a fixed time (synchronous e-learning). Among these two forms of e-learning, we include e-courses developed primarily to provide information (inform courses) as well as those designed to build specific job-related skills (perform courses).

However, the benefits gained from these new technologies depend on the extent to which they are used in ways compatible with human cognitive learning processes and based on research-based principles of instructional design. When technophiles become so excited about cutting-edge technology that they ignore human mental limitations, they may not be able to leverage

technology in ways that support learning. Instructional methods that support rather than defeat human learning processes are an essential ingredient of all effective e-learning courseware. The most appropriate methods depend on the goals of the training (for example, to inform or to perform); the learner's related skills (for example, whether they are familiar with or new to the skills); and various environmental factors, including technological, cultural, and pragmatic constraints.

In this chapter we lay the groundwork for the book by defining e-learning and identifying both the potential and the pitfalls of digital training.

What Is e-Learning?

We define e-learning as instruction delivered on a digital device (such as a desktop computer, laptop computer, tablet, or smart phone) that is intended to support learning. The forms of e-learning we examine in this book have the following features:

- Stores and/or transmits lessons in electronic form on external drives, the cloud, local internal or external memory, or servers on the Internet or intranet.
- Includes content relevant to the learning objective.
- Uses media elements such as words and pictures to deliver the content.
- Uses instructional methods such as examples, practice, and feedback to promote learning.
- May be instructor-led (synchronous e-learning) or designed for self-paced individual study (asynchronous e-learning).
- May incorporate synchronous learner collaboration as in breakout rooms or asynchronous collaboration as on discussion boards.
- Helps learners build 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 digital devices using words in the form of spoken or printed text and pictures such as illustrations, photos, animation, or video. Some forms of e-learning called asynchronous e-learning are available on demand and designed for individual self-study. We show a screen shot from an asynchronous class on Excel in Figure 1.1. These courses are typically self-paced, allowing the individual learner to access training at any time or any location on their own. Other formats, called synchronous e-learning, virtual classrooms, or webinars, are designed for real-time instructor-led training. We show a screen shot from a virtual classroom in Figure 1.2. Synchronous e-learning allows students from New York to New Delhi to attend an online class taught by an instructor in real time. However, synchronous sessions are also often recorded, allowing them to be viewed by a single learner in a self-paced (asynchronous) manner. Synchronous and asynchronous forms of e-learning may support collaboration with others through applications such as wikis, breakout rooms, chat, discussion boards, media pages, and email. Many organizations combine instructor-led virtual classroom sessions, self-study sessions, and collaborative knowledge sharing opportunities in blended learning solutions.

Figure 1.1. A Screen Capture from an Asynchronous Excel Lesson.

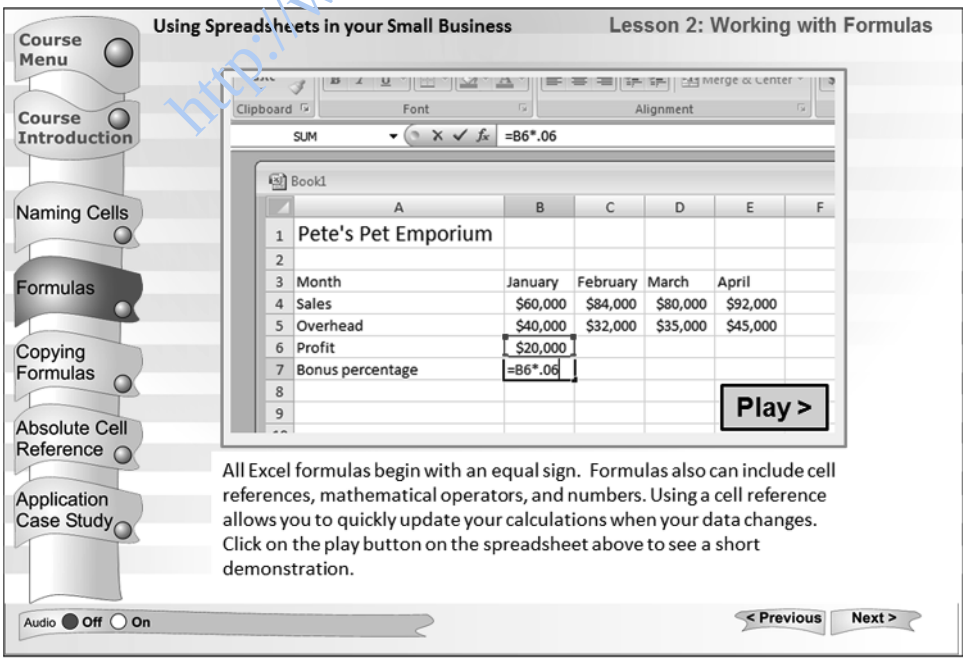
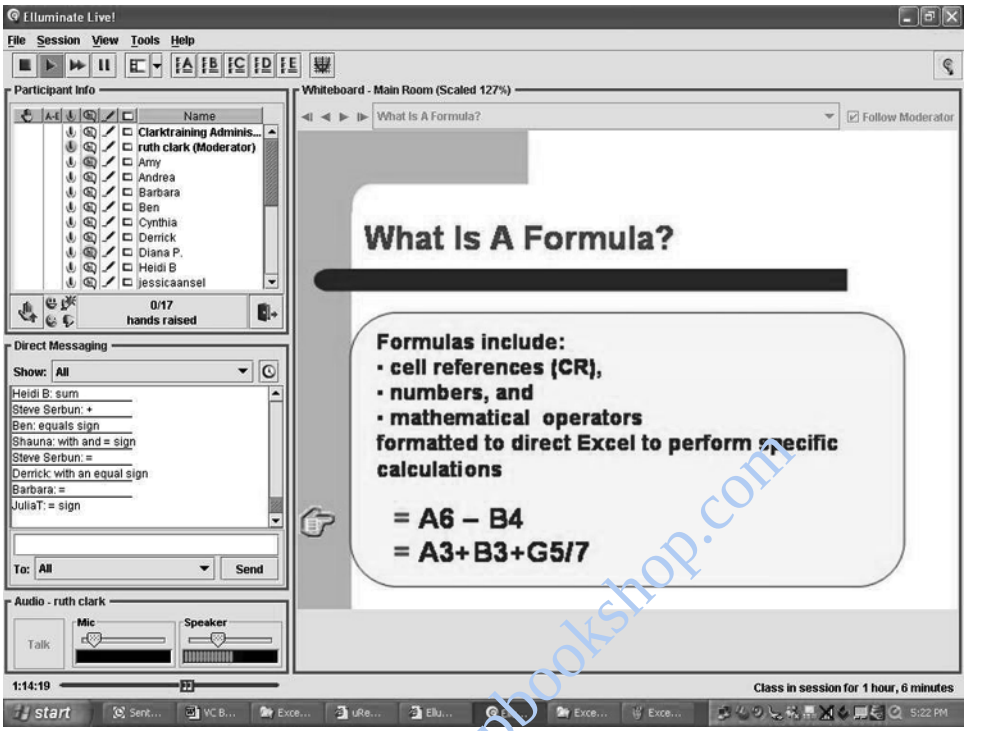


Figure 1.2. A Screen Capture from a Synchronous Excel Lesson.



Why. e-Learning lessons 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" of e-learning is the purpose: to help individuals achieve educational goals or to help organizations build skills related to improved job performance.

Our definition states 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 also apply to lessons designed for school-based or general-interest learning goals, our emphasis is on instructional programs that are designed for workforce learning. To illustrate our guidelines, we draw on actual training courseware from colleagues who have given us permission to use their examples. In addition, we have built two sets of storyboards: one

with a focus on basic Excel skills intended to illustrate a typical technology training course and a second with a focus on sales skills intended to illustrate instructional techniques that apply to more strategic skills.

In the five years since we wrote the third edition of *e-Learning and the Science of Instruction*, digital technology has continued to evolve rapidly. Blended designs integrate the benefits of technology and in-person instructional contexts. Search engines and social media make learners receivers, producers, and distributors of knowledge. Popular digital applications such as online games have prompted the use of games for learning purposes. Likewise, platforms have shrunk and diversified, giving birth to a range of mobile learning devices. As we write this chapter, the new Apple watch offers the smallest portable device with a diverse array of applications and the new Oculus Rift allows for low-cost virtual reality. No doubt instructional and performance support applications will continue to become more portable, more flexible, and more context sensitive to needs of the worker.

Is e-Learning Better?

For many training goals, you may have a choice of several delivery media. One of the least expensive options is a traditional book in printed or digital format. In-person instructor-led training augmented with slides and the occasional video is another popular option, accounting for about 55 percent of all delivery in U.S. workforce learning in 2013 (ATD, 2014). Finally, e-learning in either self-study or instructor-led formats offers a third choice. As you consider your delivery options, you might wonder whether some media are more effective for learning purposes than others.

Although technology is evolving rapidly, much of what we are seeing today under the e-learning label is not new. Training delivered on a computer, traditionally labeled computer-based training or CBT, has been available since the 1960s. Early examples delivered over mainframe computers were primarily on-screen text 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. One of the main applications of these early e-lessons was to train workers to use mainframe computer systems. As technology has evolved, acquiring greater capability to deliver rich multimedia, the courseware has become more elaborate in terms

of realistic graphics, audio, color, animation, games, and complex simulations. However, as we will see, greater media capabilities do 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 published media comparisons with the hypothesis that film teaches better than classroom instructors (see box for details). Yet after more than sixty years of research attempting to demonstrate that the latest media options are better, the outcomes fail to support the superiority of any single delivery medium over another.

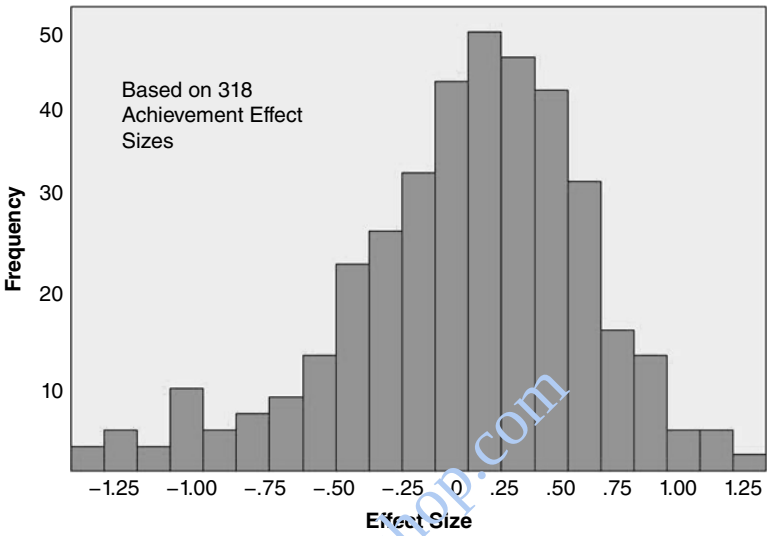
THE FIRST MEDIA COMPARISON RESEARCH

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 if 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, hundreds of media comparison studies have shown no differences in learning with different media (Clark, R.E., 1994, 2001; Dillon & Gabbard, 1998). A meta-analysis by Bernard et al. (2004) integrating research studies that compared learning from electronic distance education to learning from traditional classroom instruction yielded the achievement effect sizes shown in Figure 1.3. (See Chapter 3 for information on meta-analysis and effect sizes). As you can see, the majority of effect sizes in the bar chart are close to zero, indicating no practical differences in learning between face-to-face and electronic distance learning.

Figure 1.3. Electronic Distance Learning Versus Face-to-Face Instruction: Distribution of Effect Sizes.

Adapted from Bernard et al., 2004.



However, the bars at either end of the graph show that some distance learning courses were much more effective than classroom courses and vice versa. A review of online learning by Tallent-Runnels, Thomas, Lan, Cooper, Ahern, Shaw, and Lin (2006) concurs: "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).

From the plethora of media comparison research conducted over the past sixty years, we have learned that it's not the delivery medium, but rather the instructional methods that cause learning (Clark, R.E. 2001). When the instructional methods remain essentially the same, so does the learning, no matter which medium is used to deliver instruction. Conversely, a course that includes effective instructional methods will better support learning than a course that fails to use effective methods, no matter what delivery medium is used.

Still, we don't want to leave the impression that all media are equivalent. Each delivery environment has its tradeoffs. Books, for example, are inexpensive, self-paced, and portable, but limited to printed text and still graphics. Classroom instructor-led training offers high social presence and opportunities for hands-on practice, but is instructor-paced and content invariant, requiring all learners to proceed at the same pace and review the same content. Computers represent one of the most flexible media options as they support media elements of printed text, graphics (still and animated), and audio. Computers offer opportunities for unique engagement with simulations or with highly immersive environments that in some cases would be impossible to replicate outside a digital environment. In addition, computers offer opportunities to tailor learning opportunities that are difficult to achieve outside of one-to-one human tutoring. With Web 2.0, computers offer multi-lateral communication channels that span time and space. All of these features offer promise, but also harbor pitfalls when not used in ways congruent with human learning processes. A smart instructional solution often involves a variety of delivery contexts. Known as *blended learning,* a course may include text readings, on-the-job projects, asynchronous online pre-work assignments, an in-person classroom session followed by virtual classroom discussions, and/or discussion boards. The U.S. Department of Education reports a significant learning advantage to blended courses compared to either pure classroom-based or pure online learning (2010).

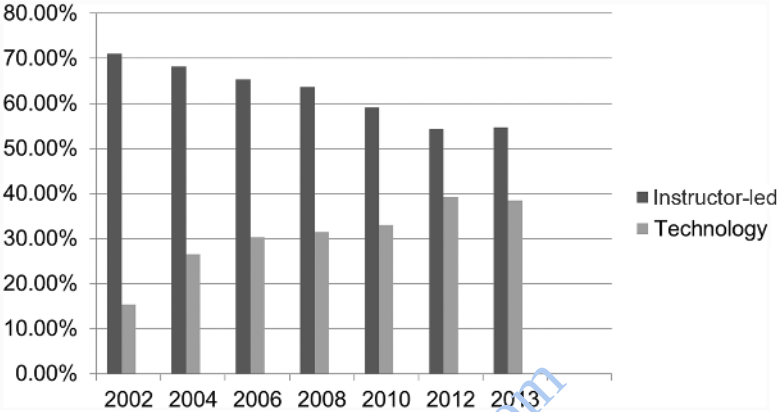
The Promises of e-Learning

How popular is e-learning in workforce learning? The trends in delivery media for the last decade shown in Figure 1.4 reveal a steadily increasing market share for digital learning. Since the first edition of *e-Learning and the Science of Instruction*, we have reported growth from approximately 11 percent technology-delivered instruction in 2001 to around 39 percent in 2011–2013 (ATD, 2014). As of 2013, in-person instructor-led classroom training still accounts for a healthy share of training hours at around 55 percent.

Organizations have looked 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. Will you leverage the potential of e-learning to provide relevant and cost-effective learning environments?

Figure 1.4. Percentage of Learning Hours Available Via Instructor-Led Classroom and Technology.

Adapted from *ATD State of Industry Report,* 2014.



Part of the answer depends on the quality of the instruction embedded in the e-learning products you are designing, building, or selecting today. We propose that the opportunities to foster learning via digital instruction rely on appropriate leveraging of five unique features that we summarize in the following paragraphs.

Promise 1: Customized Training

Self-study asynchronous e-learning has the potential to customize learning to the unique needs of each learner. By unique needs, *we don't mean learning styles*—a myth still popular among training practitioners in spite of a lack of evidence to support it (Clark, R.C., 2015; Pashler, McDaniel, Rohrer, & Bjork, 2008). By customized training we mean tailoring content, instructional methods and navigation based on the needs of individual learners. In Chapter 15 we discuss the tradeoffs between learner control and program control. Learner control in asynchronous e-learning permits learners to progress at their own pace and select topics and methods that best meet their needs. In contrast to the one-size-fits-all approach of most instructor-led training, learner control options allow learners to customize their learning environment.

Promise 2: Engagement in Learning

Regardless of delivery media, all learning requires engagement. In Chapter 11 we discuss engagement in detail, making a distinction between behavioral

and psychological engagement. By *behavioral engagement* we mean any overt action a learner takes during an instructional episode. Some examples of behavioral activities in e-learning include pressing the forward arrow, typing an answer in a response box, clicking on an option from a multiple-choice menu, verbally responding to an instructor's question, selecting an action from a pull-down menu, using text chat during a webinar, or posting assignments and comments on a discussion board. By *psychological engagement*, we mean cognitive processing of content in ways that lead to acquisition of new knowledge and skills. Some cognitive processes that lead to learning include paying attention to the relevant material, mentally organizing it into a coherent representation, and integrating it with relevant prior knowledge. Some examples of methods in e-learning intended to prime psychological engagement include adding relevant on-screen visuals, including worked out examples of problems to study prior to practice, and asking relevant questions during an online presentation.

In Chapter 11 we review research showing that behavioral activity does not necessarily promote appropriate psychological engagement for learning. In fact, some behavioral engagement methods actually depress learning compared to methods that involve less learner activity. Clicking on-screen objects to reveal definitions or playing a narrative-based instructional game are two examples of active engagement that may not promote learning. In contrast, carefully reviewing a worked out example of how to solve a problem involves little or no behavioral activity but can lead to psychological activity needed for learning. Our point is that high levels of behavioral activity don't necessarily translate into the type of psychological processing that supports learning. Likewise, meaningful learning can occur in the absence of behavioral responses. Your goal is to use media elements and instructional methods that promote psychological engagement that leads to achievement of learning objectives. In Chapter 11 we expand this theme, describing evidence-based engagement that is and is not effective.

Promise 3: Multimedia

In e-learning, you can use a combination of text, audio, as well as still and motion visuals to communicate your content and help learners acquire relevant knowledge and skills. Fortunately, we have a healthy arsenal of research to guide your best use of these media elements that we discuss in Chapters 4 through 10.

Promise 4: Acceleration of Expertise Through Scenarios

Studies of experts across a wide variety of domains show that about ten years of experience are needed to reach high levels of proficiency (Ericsson, 2006). In some work settings, getting that experience can take years because situations that require certain skills rarely present themselves. e-Learning, however, offers opportunities to immerse learners in job-realistic environments requiring them to solve infrequent problems or complete tasks in a matter of minutes that could take hours or days to complete in the real world. For example, when troubleshooting equipment, some failures are infrequent and may require considerable time to resolve. A computer simulation such as the one shown in Figure 1.5 can emulate those failures and give learners opportunities to resolve them in a realistic work environment. In Chapter 16 we discuss e-learning programs such as this one designed to build thinking skills.

Figure 1.5. A Simulated Automotive Shop Offers Accelerated Learning Opportunities.
With permission from Raytheon Professional Services.

Promise 5: Learning Through Digital Games

An emerging theme in workforce learning involves adding games as a form of engagement, an approach known as gamification. Mayer (2014) lists the following characteristics of games: (1) rule-based simulated systems, (2) responsive to the player, (3) challenging, (4) cumulative, allowing for assessment of progress toward goals, and (5) inviting, offering appeal and interest for the

learners. The goal of gamification is to provide learning experiences that are motivating, engaging, and effective. Considerable research progress has been made to define the features that make games effective for learning. We summarize that evidence in Chapter 17.

The Pitfalls of e-Learning

The powerful features of e-learning are a two-edged sword with many potential traps that sabotage learning. Here we summarize some of the major pitfalls that can rob your organization of a return on investment in digital learning:

Pitfall 1: Too Much of a Good Thing

As we will see in Chapter 2, the human cognitive system is limited and, when it comes to instruction, less is often more. It's tempting to use an eye-catching mix of animations, sounds, audio, and printed text to convey your content. However, we have good evidence to support our advice: *Don't do it*! Read Chapter 8 on the Coherence Principle for evidence on our theme that often students learn more content when less glitz is presented.

Pitfall 2: Not Enough of a Good Thing

At the other end of the spectrum you can find e-learning that, in fact, is minimalist in that it fails to make use of features proven to promote learning. For example, a *wall of words* approach ignores opportunities to leverage relevant visuals by providing explanations that use text and more text. Alternatively, some forms of e-learning, called page turners, omit interactivity other than the forward and back button. These courses may present screen after screen of stunning visuals, but without overt engagement most learners lose attention within fifteen minutes at best (Hattie & Yates, 2014).

Pitfall 3: Losing Sight of the Goal

In 2013, approximately $165 billion were invested in workforce learning in the United States alone (ATD, 2014). We suspect there is little evidence of return on that investment—a safe speculation on our part because the majority of organizations don't invest the time or resources to assess outcomes from their training. Regardless of delivery medium, any training development process must identify key skills that promote organizational goals and build training around the tasks that constitute those skills. Be it games, virtual worlds, or social media, technophiles gravitate toward the latest cool

trends—sometimes without considering whether and how best to leverage them in ways that support relevant learning.

Pitfall 4: Discovery Learning

Because the metaphor of the Internet is high learner control, allowing users to search, locate, and peruse thousands of Internet sites, a tempting pitfall involves highly exploratory learning environments that give learners an unrestricted license to navigate and piece together their own unique learning experiences. One lesson we have learned from over fifty years of research on pure discovery learning is that it rarely works (Mayer, 2004). Instead, we recommend a structured form of e-learning that provides appropriate guidance for learners.

Inform and Perform e-Learning Goals

As summarized in Table 1.1, 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 module that reviews the company history and describes the company organization, a product knowledge update, or a summary of policies and procedures for compliance purposes are examples of topics that are often presented as inform programs. The information presented is job relevant but there may be no specific expectations of new skills to be acquired. The primary goal of these programs is to transmit information.

Table 1.1. Inform and Perform e-Learning Goals.

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

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, customer service, or troubleshooting an equipment failure. Many e-courses contain both inform and perform learning objectives, while some are designed for inform only or perform only.

Near Versus Far Transfer Perform Goals

We distinguish between two types of perform goals: (1) procedural, which promote *near transfer*, and (2) strategic, which promote *far transfer*. Procedural lessons such as the Excel examples in Figures 1.1 and 1.2 are designed to teach step-by-step tasks, which are performed more or less the same way each time. Many end-user computer-skills courses fall into this category. This type of training promotes 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.

Lessons designed to build strategic skills, which promote far transfer skills, are designed to teach general approaches to tasks 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. Far transfer tasks require the worker to adapt guidelines 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 1.5 illustrates a screen from a far-transfer course on troubleshooting. The lesson begins with a work order specifying a problem symptom in the automobile. The learner has access to the testing equipment you see in the shop to take and record measurements. The shop computer links the learner to actual online reference resources and a telephone offers testing hints. When learners are ready to interpret the data collected, they select the appropriate failure and repair action from a list. As feedback, a list of testing activities and times from an expert repair is displayed next to a list of the learner's activities and times, which were tracked during the learner's progress through the lesson.

e-Learning Architectures

Although all e-learning is delivered on a digital device, 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 reflected in courses available today. Table 1.2 presents three architectures and a summary of the learning assumptions on which they are based: *receptive architectures* based on an *information acquisition* view, *directive* architectures based on a *response strengthening* view (that is, learning involves strengthening and weakening connections), and *guided discovery architectures* based on a *knowledge construction* view (that is, learning involves building cognitive structures).

Table 1.2. Three e-Learning Architectures.

Architecture	*View*	*Behavioral Engagement*	*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 consultative selling

Interactivity in the Architectures

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 behavioral interactivity continuum as they mainly present information and incorporate few opportunities for overt learner responses. Many of these opportunities are recall interactions that may not promote transfer to the workplace. Receptive lessons are used most frequently for inform training goals. For learning to occur, the lesson must include techniques that prompt high psychological engagement in the absence of behavioral activity such as relevant visuals and worked examples.

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 1.1 and 1.2 reflect a directive architecture. The high degree of structure and guidance in directive architectures makes them suitable for learners who are new to the content and skills.

Effective guided discovery forms of e-learning, including simulations and games, ask learners to perform tasks while receiving guidance and thereby engage learners both behaviorally and psychologically. For example, Figure 1.5 shows the interface for a guided discovery course in which the learner is problem solving by selecting and interpreting troubleshooting tests leading to accurate diagnosis of an automotive failure. We describe guided discovery architectures in Chapters 16 and 17. Because these types of lessons require learners to solve a problem and learn from its solution, they impose more mental load than the directive architectures. Therefore, they are generally more appropriate for more experienced learners and for building far-transfer skills.

Learning is possible from any of these three architectures if learners engage in active knowledge construction. In receptive courses, you will want to use media elements and instructional methods that stimulate psychological activity in the absence of behavioral activity. We review many proven methods of this type in Chapters 4 through 10. In directive and guided discovery architectures, knowledge construction is overtly promoted by the interactions built into the lessons. In the next chapter, we dig a little deeper into the psychological processes needed for learning and how instructional methods can support or defeat those processes.

What Is Effective e-Courseware?

A central question for our book is, "What does effective 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 three main considerations—the goal of your training, the prior knowledge of your learners, and the context in which you will develop and deploy your training.

Training Goals

The goals or intended outcomes of your e-learning will influence which guidelines are most appropriate for you to consider. Previously 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, you should apply the guidelines in Chapters 4 through 12 regarding the best use of media elements, including visuals, narration, and text to present information, how to use examples effectively, and how to use methods that promote psychological engagement. To help learners acquire procedural skills, you should apply these guidelines and add to them relevant evidence for best design of practice sessions summarized in Chapter 13. 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 16 on teaching problem-solving skills and Chapter 17 on games.

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 shown 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 strategies than 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 6 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 either text or audio explanations of visuals.

Context

A third factor that affects e-learning is the context—including such issues as technical constraints of the delivery platform, network, and authoring software, policies related to learning management systems, 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 context.

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 strategies 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 regularly, 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 attention-grabbing 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-five 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.

WHAT TO LOOK FOR IN e-LEARNING

In this section of each chapter we will provide a checklist based on the research we have summarized in the chapter. Use this as a job aid as you design or evaluate e-learning courses.

☐ One or more of the unique features of e-learning are used:

- Learners can control their pacing through a lesson.
- Engagement methods promote appropriate psychological processing.
- Lessons include appropriate use of graphics and words to present content.
- Job-realistic scenarios are used as a context for learning.

☐ The dominant architecture (Receptive, Directive, or Guided Discovery) is appropriate for the instructional goals.

- The instructional environment blends different media exploiting the strengths of each.
- Sufficient guidance is included to avoid discovery learning
- The use and design of new approaches such as social media and games are appropriate to the learning goal.

Chapter Reflection

1. Based on the e-courses you have taken or designed, which architectures (receptive, directive, guided discovery) have you noticed? Does any one of them predominate? Would you recommend using different architectures?
2. Some individuals have predicted the demise of the in-person classroom, to be replaced by digital learning environments. Do you agree? Provide reasons for your opinion.
3. Which of the promises or pitfalls of e-learning have you seen? What do you think has been a barrier to realizing promises and an incentive to incorporate pitfalls?

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 examples of how instructional methods used in e-lessons support cognitive processes.

Suggested Readings

Clark, R.C. (2014). Multimedia learning in e-courses. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 842–881). New York: Cambridge University Press. *For a more technical review of many of the topics we include in this book, we will recommend relevant chapters from this resource.*

Clark, R.C. (2015). *Evidence-based training methods* (2nd ed.). Alexandria, VA: ATD Press. *This book includes much of the research we discuss in this book. However, the focus is on all instructional environments, not just digital learning.*

Clark, R.E. (1994). Media will never influence learning. *Educational Technology Research and Development*, *42,* 21–30. *This is a classic paper; one of the first to clearly distinguish instructional media from instructional methods.*

Hattie, J., & Yates, G. (2014). *Visible learning and the science of how we learn*. New York: Routledge. *This book, focused primarily on classroom learning, synthesizes the results of many research studies on the most important influences on learning.*

Mayer, R.E. (2004). Should there be a three-strikes rule against pure discovery learning: The case for guided methods of instruction. *American Psychologist*, *59*(1), 14–19. *A classic paper that reviews years of evidence showing the benefits of guided versus discovery instructional designs.*

Mayer, R.E. (2014b). Introduction to multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 1–24) New York: Cambridge University Press. *This is the first chapter in the Handbook, which discusses many of the same ideas we introduce in this first chapter.*