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e-Learning and the Science of Instruction

By: Ruth Colvin Clark & Richard E. Mayer

Book Facts

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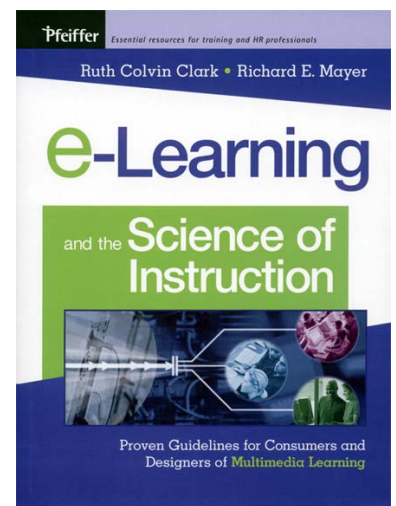
How to Buy It

- Call Pfeiffer Publishing at 800-274-4434
- www.pfeiffer.com
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Overview

E-Learning and the Science of Instruction combines practical application and solid research to provide guidelines for selecting, designing, and developing e-learning courses that build knowledge and skills for workers learning in corporate, government, and academic settings.

This book also includes guidelines on a range of learning issues including the best use of text, visuals, and audio. Each chapter includes examples drawn from Internet and CD-ROM courseware and checklists of “what to look for” in e-learning courses you are reviewing or designing. The book also has “design dilemmas” throughout in order to further one’s knowledge on e-learning lessons. You will always be able to learn not only the what, but the why, behind effective e-learning.



Media Element Guidelines for e-Learning

There are six different media element guidelines to follow when doing e-Learning instruction. These guidelines are outlined in the book. They include:

1. **The Multimedia Principle:** Use words and graphics rather than words alone.
2. **The Contiguity Principle:** Place corresponding words and graphics near each other
3. **The Modality Principle:** Present words as audio narration rather than onscreen text.
4. **The Redundancy Principle:** Presenting words in both text and audio narration can hurt learning.
5. **The Coherence Principle:** Adding interesting material can hurt learning
6. **The Personalization Principle:** Use conversational style and virtual coaches.

These six different guidelines follow closely to the research that has been done to find the best use of media elements—sound, graphics, and text. These guidelines have been used to increase the learning effectiveness of e-lessons. All of these provide baseline guidelines of broad applicability, and summarize over ten years of research that was conducted by Richard Mayer at the University of California, Santa Barbara.

The Goals and Pitfalls of e-Learning

“How internet learning will shake out, I really do not know. But I am utterly convinced that over the next ten years we will see shifts from in-residence learning to on-line learning.”
-Gerhard Casper

The book specifies the two types of e-Learning goals, which are inform and perform.

- **Inform:** Lessons that communicate information
Example: Company history or New product features
- **Perform-Procedure:** Lessons that build procedural skills
Example: How to log on or complete a form.
- **Perform Principle:** Lessons that build principle-based skills
Example: How to close a sale or How to design a web page.

Lessons that are primarily built for awareness or to provide information are known as the inform programs, and programs built to help specific skills are known as perform programs.

The book specifies three different pitfalls of e-Learning.

- 1. Failure to Define Job Knowledge and Skills**
Result: Lessons do not build knowledge and skills that transfer to the job
- 2. Failure to Accommodate Learning Processes**
Result: Lessons overload cognitive processes and learning is disrupted.
- 3. Attrition**
Result: Learners do not complete their instruction

Effective Practice Principles for e-Learning

“An important instructional implication of the focus on metacognition is that problem solving skills should be learned within the context of realistic problem-solving situation.”
- Richard Mayer

“E-Learning should promote psychological engagement between the learner and the lesson content in ways that help learners to select, integrate, and retrieve new knowledge.”

A path that can be used to achieve this learning process is the use of practice exercises. These exercises are often referred to as interactions in computer learning environments.

Based on empirical evidence, the authors recommend four principles for effective practice in e-Learning, they are as follows:

- **Practice Principle One:** Interactions Should Mirror the thinking process and environment of the job
** E-Learning designers should create transfer appropriate interactions. These are activities that require learners to respond in similar ways during training as they will on the job.*

- **Practice Principle Two:** Critical Tasks Require More Practice
** For critical tasks, for example safety consequences, the authors recommend lots of practice.*
- **Practice Principle Three:** Apply the Media Elements Principles to Practice Exercises.
** Make sure that the practice exercises for each principle is specific to what the principle is teaching.*
- **Practice Principle Four:** Train learners to Self-Question during receptive e-Lessons.
** Train learners to self-question by showing examples of self-questioning followed by practice that requires learners to self-question instructional materials.*

Worked Example Principles & Collaborative Learning

Worked examples are a powerful method that you can use to build new and rich knowledge in long-term memory. Worked examples are usually the most popular with the learners because they often choose worked examples over verbal descriptions. They are step-by-step demonstrations of how to perform tasks or solve problems. The four worked example principles to follow are:

- Worked examples should replace some practice exercises for novice learners.
- Principles regarding best use of text, audio, and graphics are applied to present worked examples.
- Worked examples are job realistic and diverse to build useful mental models for procedural and principle-based job tasks.
- Training in self-explanation of examples is important.

The book defined *collaborative learning* as a structured exchange between two or more participants designed to enhance achievement of the learning objectives. Some common applications of collaborative learning are chats, message boards, threaded discussion boards, online conferencing, email, and list-servs. There are three guidelines the authors have outlined to show the best practices for implementation of collaborative learning in classroom environments.

- Make assignments that require collaboration among learners.
- Assign learners to groups in ways that optimize interaction.
- Structure group assignments around products or processes.

“Interpreting a worked example may be redundant and impose a greater cognitive load that simply providing a solution to the problem.”
-Journal of Educational Psychology

Learner Control & Problem-Solving Principles

Learner control has always been popular with learners since it allows the learners to select topics and instructional elements that they prefer. Many learners do not always make good instructional decisions, so here are some basic principles to follow when it comes to learner control.

- Use learner control for learners with high prior knowledge or mega cognitive skills and/or in lessons or courses that are advanced rather than introductory.
- When learner control is used, design that default navigation options to lead to important instructional course elements.
- Include advice based on valid test questions to help learners make effective instructional decisions.

In this book you can also learn about the use of e-learning courseware to demonstrate problem-solving actions and thoughts. The book also provides practices for problem-solving in realistic job cases. There are three outlined principles that you should follow when teaching problem solving.

- Use real job contexts to build work-specific problem-solving skills.
- Provide expert models of problem-solving actions and thoughts.
- Promote learner awareness of their problem-solving actions and thoughts.

“Contrary to intuition, poor calibration of comprehension is the rule, rather than the exception.”
-A.M. Glenberg

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About the Authors

"For me this book started about five years ago at a conference presentation on e-learning. After the presentation, participants asked questions about issues related to learner control, questioning techniques, and screen design. Many questions had a familiar ring. They were the same as the questions raised years ago during the pioneer computer-based training (CBT) days of the late 1970s and early 1980s. I realized we now have a new generation of CBT consumers and designers who did not have the advantage of the lessons learned from those early e-learning trials. Additionally many do not have the benefits of the last fifteen years of research on cognitive learning methods that have significantly added to our knowledge about what helps and what hinders learning.

I had the opportunity to meet my co-author, Richard Mayer, at an ASTD committee meeting in late 2000. I knew of his research on e-learning from his extensive publications in academic journals and from his book, *Multimedia Learning*. I knew that he had published the results of many controlled experiments focusing on basic critical issues around the design of multimedia – issues that practitioners face routinely in their e-learning work. I was delighted that he agreed to work with me on this project and that we could draw on his work as a major resource for the book.

Our goal in this book is to help you as an e-learning consumer or as part of an e-learning design team to profit from the work of the academic community. To this end we have written the chapters to focus on critical issues you face for which there are research-based recommendations. We have worked to translate empirical studies into readable guidelines and make them useful through checklists and e-learning examples. We hope that our effort will help you make better e-learning selection and design decisions that reflect research on instructional methods."

April 2002, Ruth Colvin Clark

Ruth Colvin Clark has worked for more than twenty years with managers assigned to design, develop, and elect effective training for classroom or computer delivery. She is widely published in areas of training, development, and performance improvement. Her most recent book, *Building Expertise*, was awarded Outstanding Instructional Communication from ISPI.

Richard E. Mayer is professor psychology at the University of California, Santa Barbara. He is an internationally recognized expert in the application of learning psychology to design of instruction in multimedia learning environments and the author of *Multimedia Learning*.

Both of the authors are committed to the use of empirical evidence to inform decisions about what works best in e-learning. Together the authors wanted to summarize the research around critical decisions that must be made about e-learning and to present it in a readable format that practitioners will find useful. They both have hopes that readers will find useful guidance based on what is known today in the chapters of the book. You can reach the authors at:

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