

# The Cambridge Handbook of Multimedia Learning

During the past 10 years, the field of multimedia learning has emerged as a coherent discipline with an accumulated research base that has never been synthesized and organized in a handbook. *The Cambridge Handbook of Multimedia Learning* constitutes the world's first handbook devoted to comprehensive coverage of research and theory in the field of multimedia learning. Multimedia learning is defined as learning from words (e.g., spoken or printed text) and pictures (e.g., illustrations, photos, maps, graphs, animation, or video). The focus of this handbook is on how people learn from words and pictures in computer-based environments. Multimedia environments include online instructional presentations, interactive lessons, e-courses, simulation games, virtual reality, and computer-supported in-class presentations. *The Cambridge Handbook of Multimedia Learning* seeks to establish what works (i.e., to determine which features of a multimedia lesson affect learning), to explain how it works (i.e., to ground research in cognitive theory), and to consider when and where it works (i.e., to explore the implications of research for practice).

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# The Cambridge Handbook of Multimedia Learning



*Edited by*

**Richard E. Mayer**

*University of California, Santa Barbara*



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## Preface

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During the past 10 years, the field of multimedia learning has emerged as a coherent discipline with an accumulated research base that has never been synthesized and organized in a handbook. *The Cambridge Handbook of Multimedia Learning* constitutes the world's first handbook devoted to comprehensive coverage of research and theory in the field of multimedia learning. For purposes of the *Handbook*, multimedia learning is defined as learning from words (e.g., spoken or printed text) and pictures (e.g., illustrations, photos, maps, graphs, animation, or video). The focus of the *Handbook* is on how people learn from words and pictures in computer-based environments. Multimedia environments include online instructional presentations, interactive lessons, e-courses, simulation games, virtual reality, and computer-supported in-class presentations. Overall, the *Handbook* seeks to establish what works (i.e., to determine which features of a multimedia lesson affect learning), to explain how it works (i.e., to ground research in cognitive theory), and to consider when and where it works (i.e., to explore the implications of research for practice).

What distinguishes this book from edited books on distance learning or Web-based instruction is our commitment to taking a scientific, evidence-based approach. My goal as editor is to provide a comprehensive and focused overview of the state of scientific research on multimedia learning. Each chapter is based on empirical research and grounded in cognitive theory, rather than offering unsubstantiated recommendations, describing best practices, or summarizing software development accomplishments. As the first comprehensive research-based handbook on multimedia learning, *The Cambridge Handbook of Multimedia Learning* is intended to define and shape the field for years to come.

There are many books providing advice on how to design multimedia-learning environments, but these books are largely based on the practical experience and wisdom of the authors. Similarly, there are books reporting on the development of online instructional programs and Web sites, but these reports of development efforts are generally based on best practices and informal case studies. Until recently, the lack of scientific research evidence in many



multimedia-learning books could be justified on the grounds that a solid research base did not yet exist. However, the quantity and quality of scientific research – conducted by researchers around the world – has reached a level warranting the field's first comprehensive research-based handbook of multimedia learning.

As editor, I asked the world's leading multimedia researchers to author chapters in areas in which they have contributed to the empirical research base. In particular, I sought authors who are leading researchers in the field of multimedia learning – that is, those with the strongest records of research publication. Because the field is largely international, the chapter authors for the *Handbook* span the globe. Each chapter author had a specific charge – that is, directions to review a well-defined subarea such as the role of online worked-out examples or the role of speech versus on-screen text. The chapters in each section follow the same general structure: describing the major research issue or question, providing examples of the research issue or question, summarizing research in which measures of learning are the central focus, critiquing the research, and discussing implications for theory and practice.

The *Handbook* consists of 35 chapters organized into five parts. Each chapter focuses on a particular theory of multimedia learning (part 1), a basic principle of multimedia learning (part 2), an advanced principle of multimedia learning (part 3), multimedia learning in a content area (part 4), or multimedia learning within an advanced computer-based context (part 5). In order to provide a common structure among the chapters of the *Handbook*, I asked authors to organize their chapters around a common set of issues. In particular, I asked the authors of the theory chapters in part 1 to provide a concise description of the theory or model with concrete examples, to summarize the theory's contributions to cognitive theory (i.e., to specify predictions that have been tested), to summarize the theory's contributions to instructional design (i.e., to specify recommendations for instruction), to

describe any limitations of the theory, and to suggest future directions for research. I asked the authors of each of the other chapters to provide a clear definition and example of the central principle or topic of the chapter, to review the relevant published research literature in sufficient detail, to assess the limitations of the research base, to summarize the implications for cognitive theory and instructional design, and to suggest directions for future research.

I solicited chapters that were concise (i.e., containing no more than 25 double-spaced pages), focused (i.e., reviewing the research on a specified topic), well-referenced (i.e., containing a rich set of relevant references), evidence-based (i.e., providing an up-to-date review of the best empirical evidence), theory-based (i.e., relating the findings to testable predictions of theories when appropriate), and educationally relevant (i.e., drawing implications for educational practice when appropriate). In order to minimize confusion, I asked authors to clearly define jargon terms in the text as well as in a glossary at the end of the chapter. Each chapter was reviewed and revised.

The intended audience includes anyone interested in how people learn from words and pictures in computer-based environments. Although this handbook summarizes the research base in multimedia learning, it is intended to be accessible to a general audience. On one hand, this handbook is designed to support readers with practical interests in how to design or select multimedia learning environments that promote learning. On the other hand, this handbook is designed to support readers who have academic interests in conducting or evaluating research in multimedia learning. The *Handbook* would be appropriate for courses related to cognitive science, educational psychology, instructional design, human factors, multimedia arts and technology, professional training, and interface design. It also would be useful for instructors interested in designing or improving multimedia lessons in school settings, job training contexts, and informal environments. In short, *The Cambridge Handbook of Multimedia Learning*

belongs on the bookshelf of anyone who is interested in an evidence-based approach to Web-based learning, e-learning, hypermedia, multimedia, Web site design, distance learning, instructional technology, human-computer interaction, virtual environments, or applied cognitive psychology.

As editor, I have tried to ensure that this handbook reflects the values that I think are important for our field. In particular, I sought to produce a handbook that is:

*research based* – The *Handbook* is intended to summarize the empirical research on multimedia learning, rather than describe untested best practices or software development projects. Although I have much respect for the craft knowledge of practitioners and designers, it is important to know if recommendations are supported by scientific evidence and under what conditions they are supported. Thus, I value a focus on scientific evidence as the key to progress in our field.

*theory grounded* – The *Handbook* is intended to relate empirical research to cognitive theories of how people learn. My overriding premise is that multimedia learning environments should be designed in ways that are consistent with what is known about how people learn.

*educationally relevant* – The *Handbook* focuses on issues that are relevant to education, that is, to helping people learn. Thus, I sought chapters that offer research-based implications for instructional design.

*comprehensive* – The *Handbook* offers a broad view of the field, including contributions from multimedia researchers around the world. I value the perspectives of researchers who have devoted so much of their energy to understanding multimedia learning.

*timely* – The *Handbook* offers an up-to-date overview of the field. I value timeliness because the scientific study of multimedia learning is maturing at

a rapid pace, and so are the practical demands for building multimedia learning environments – ranging from e-courses to in-class simulations.

*readable* – In my role as editor I have tried to ensure that the chapters are clear and concise, with key terms defined and concrete examples provided. In a multidisciplinary field such as this one, it is important that the chapters communicate what is known in a way that general readers can appreciate.

In short, my values have motivated me to seek chapters that are based on empirical research and grounded in cognitive theory rather than chapters that mainly describe development efforts or best practices.

Editing this book has been a treat for me, because I could commission chapters from the best researchers in the field and be the first to learn what they had to say. I am pleased to share the fruits of this enterprise with you in a timely fashion. My hope is that you enjoy reading this handbook as much as I have enjoyed editing it. I will consider this handbook to be a success if it helps you to understand what is known about how people learn from words and pictures; gives you useful help in building or selecting effective multimedia learning environments; or encourages you to produce or investigate research that contributes to cognitive theory and educational practice. I hope that you will feel free to contact me at [mayer@psych.ucsb.edu](mailto:mayer@psych.ucsb.edu) to share your comments about *The Cambridge Handbook of Multimedia Learning*.

## Acknowledgments

Although my name is listed as the editor, this handbook depended on the contributions of many people. In particular, I thank the authors for producing excellent chapters, for keeping this project on schedule, and for responding so well to the reviewer's comments. I thank the members of the handbook's editorial board – John Sweller, Jeroen van Merriënboer, and

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