

Cambridge University Press
978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding
Logan Fiorella and Richard E. Mayer
Frontmatter
[More information](#)

LEARNING AS A GENERATIVE ACTIVITY

During the past twenty-five years, researchers have made impressive advances in pinpointing effective learning strategies (i.e., activities the learner engages in during learning that are intended to improve learning). In *Learning as a Generative Activity: Eight Learning Strategies That Promote Understanding*, Logan Fiorella and Richard E. Mayer share eight evidence-based learning strategies that promote understanding: summarizing, mapping, drawing, imagining, self-testing, self-explaining, teaching, and enacting. Each chapter describes and exemplifies a learning strategy, examines the underlying cognitive theory, evaluates strategy effectiveness by analyzing the latest research, pinpoints boundary conditions, and explores practical implications and future directions. Each learning strategy targets generative learning, in which learners actively make sense of the material so they can apply their learning to new situations. This concise, accessible introduction to learning strategies is intended to benefit students, researchers, and practitioners in educational psychology, as well as general readers interested in the important twenty-first-century skill of regulating one's own learning.

Logan Fiorella is a Ph.D. candidate in psychology at the University of California, Santa Barbara (UCSB). His research focuses on identifying learning and instructional strategies that promote meaningful learning, particularly in the science, technology, engineering, and mathematics fields. He was awarded a Junior Scientist Fellowship from the American Psychological Association of Graduate Students as well as the Richard E. Mayer Award for Outstanding Research Contribution in Psychology from UCSB's Department of Psychological and Brain Sciences.

Richard E. Mayer is Professor of Psychology at the University of California, Santa Barbara. He served as president of Division 15 (Educational Psychology) of the American Psychological Association and as vice president of the American Educational Research Association for Division C (Learning and Instruction). He has received many awards, including the E. L. Thorndike Award for career achievement in educational psychology and the Sylvia Scribner Award for career research in learning and instruction. He has authored more than five hundred publications, including thirty books, among them *Applying the Science of Learning*, *Multimedia Learning*, *Learning and Instruction*, *e-Learning and the Science of Instruction* (with R. Clark), and *Computer Games for Learning*.

Cambridge University Press

978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding

Logan Fiorella and Richard E. Mayer

Frontmatter

[More information](#)

Cambridge University Press
978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding
Logan Fiorella and Richard E. Mayer
Frontmatter
[More information](#)

Learning as a Generative Activity

EIGHT LEARNING STRATEGIES THAT
PROMOTE UNDERSTANDING

Logan Fiorella

University of California, Santa Barbara

Richard E. Mayer

University of California, Santa Barbara



CAMBRIDGE
UNIVERSITY PRESS

Cambridge University Press
978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding
Logan Fiorella and Richard E. Mayer
Frontmatter
[More information](#)

CAMBRIDGE
UNIVERSITY PRESS

32 Avenue of the Americas, New York, NY 10013-2473, USA

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781107069916

© Logan Fiorella and Richard E. Mayer 2015

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2015

Printed in the United States of America

A catalog record for this publication is available from the British Library.

ISBN 978-1-107-06991-6 Hardback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party Internet Web sites referred to in this publication and does not guarantee that any content on such Web sites is, or will remain, accurate or appropriate.

Cambridge University Press
978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding
Logan Fiorella and Richard E. Mayer
Frontmatter
[More information](#)

CONTENTS

<i>Preface</i>	<i>page</i> vii
<i>Acknowledgments</i>	xiii
<i>About the Authors</i>	xv
1 Introduction to Learning as a Generative Activity	1
2 Learning by Summarizing	20
3 Learning by Mapping	38
4 Learning by Drawing	62
5 Learning by Imagining	79
6 Learning by Self-Testing	97
7 Learning by Self-Explaining	124
8 Learning by Teaching	151
9 Learning by Enacting	167
10 Learning Strategies That Foster Generative Learning	192
<i>Author Index</i>	207
<i>Subject Index</i>	213

Cambridge University Press

978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding

Logan Fiorella and Richard E. Mayer

Frontmatter

[More information](#)

Cambridge University Press
978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding
Logan Fiorella and Richard E. Mayer
Frontmatter
[More information](#)

PREFACE

WHAT IS THIS BOOK ABOUT?

The ability to learn gives humans a tremendous advantage and enables our progress in developing as individuals and as a species. What does the research say about how to improve student learning? If you are interested in the answer to this question, this book is for you. During the past twenty-five years, researchers have made impressive advances in pinpointing effective learning strategies – that is, activities that the learner engages in during learning intended to improve learning. In *Learning as a Generative Activity: Eight Learning Strategies That Promote Understanding*, we share eight evidence-based learning strategies that improve learning, so you can get a better sense of what the research is telling us.

Learning as a Generative Activity: Eight Learning Strategies That Promote Understanding provides a concise and focused introduction to what we consider to be the eight most effective learning strategies for improving student learning. The unifying goal of the book is to take an evidence-based approach to “what works” in helping people learn. In particular, we focus on eight ways to foster *generative learning* – that is, helping learners to actively make sense of the material so they can build meaningful learning outcomes that allow them to transfer what they have learned to solving new problems. Each of the core chapters (a) describes and exemplifies an effective learning strategy, (b) considers the underlying cognitive theory, (c) summarizes the research base to assess the level of effectiveness, (d) notes the boundary conditions under which the strategy is most effective, (e) suggests practical implications, and (f) explores future directions. By using the same organization in each chapter and a friendly writing style, we intend to make the book accessible to a diverse array of readers.

WHY DID WE WRITE THIS BOOK?

Students of the twenty-first century need to learn how to come up with creative solutions to new problems, how to adapt to changing situations, how to integrate multiple sources of information, and how to make and understand arguments based on evidence. To do this, they need to learn in ways that promote understanding so they can create *transferable knowledge and skills* – that is, knowledge and skills that they can use to solve new problems they have not encountered before. The ability to transfer what you have learned to new situations is the primary outcome of generative learning. We wrote this book in order to explore how to promote generative learning.

WHAT DO WE MEAN BY “LEARNING
AS A GENERATIVE ACTIVITY”?

What do we mean by learning? Learning is a change in what you know caused by your experience. Some theories view learning as strengthening a response for a given stimulus, such as learning to say “four” when the teacher says, “What is two plus two?” Some theories view learning as adding facts to memory for later retrieval, such as memorizing the definition of *learning* in the second sentence of this paragraph. These conceptions of learning may be useful for particular learning situations – such as response learning or rote memorizing, respectively. In this book, however, we focus on a third conception of learning as a process of sense making, in which you try to understand what is presented by actively selecting relevant pieces of the presented information, mentally organizing them, and integrating them with other knowledge you already have. Engaging in these three cognitive processes during learning (i.e., selecting, organizing, and integrating) is what we mean by generative learning.

This book is based on current research-based theories of how people learn, which can be called the *science of learning*. In particular, generative learning involves the learner engaging in appropriate cognitive processing during learning, including selecting relevant incoming material to attend to, organizing the material into a coherent cognitive structure in working memory, and integrating it with relevant prior knowledge activated from long-term memory. Learning is a generative activity when learners actively generate their own learning outcomes by interpreting what is presented to them rather than by simply receiving it as presented. According to generative theory, learning is a selective activity, a structure-building

activity, and a knowledge-integration activity. Those kinds of processing can be influenced by the student's learning strategy – a study technique such as summarizing the material in one's own words – or the instructor's instructional method – a way of presenting the material, such as providing an advance organizer that summarizes background material before the lesson. In short, the outcome of learning depends both on the material presented to the learner and the learner's cognitive activity during learning. Effective teaching requires more than simply presenting the to-be-learned material to the learner; it also requires guiding the learner's cognitive processing of the material during learning. In this book, we focus on effective learning strategies for priming appropriate cognitive processing during learning.

WHY HAVE WE LIMITED THE BOOK TO “EIGHT LEARNING STRATEGIES THAT PROMOTE UNDERSTANDING”?

In reviewing the research base on what works in helping people learn, we were exhilarated to find many important discoveries to share. However, in the interest of giving you a concise introduction, we decided to limit this book to what we consider to be the eight most effective learning strategies. Our goal is to show you examples of what works, when it works, and how it works. Rather than trying to cover everything that we know at a superficial level, we instead go into some depth on eight important techniques that have strong evidence and high relevance for improving academic learning.

WHAT ARE THE MERITS OF TAKING AN EVIDENCE-BASED APPROACH?

There are plenty of books on the market that provide practical advice on how to study, but many are based on the wisdom of the author rather than on research evidence. Although expert advice can be helpful, we think an evidence-based approach such as taken in this book also can be helpful, especially in light of the advances being made in educational psychology research. Alternatively, you could try to navigate your way through massive research handbooks, with each chapter written by a different author, but in this book we have made your job a little easier by providing a concise and focused review of eight effective ways to help people learn. By looking at research evidence, you will have a surer sense of what works in helping people learn.

Cambridge University Press
978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding
Logan Fiorella and Richard E. Mayer
Frontmatter
[More information](#)

HOW IS THE BOOK ORGANIZED?

The book consists of an introductory chapter that spells out the rationale for studying how to improve student learning, defines and exemplifies learning strategies, and provides a theoretical framework for learning as a generative activity. Generative learning theory is based on the idea that effective learners engage in appropriate cognitive processing during learning, including selecting key information, mentally organizing it, and integrating it with relevant prior knowledge. The goal is to help learners produce meaningful learning outcomes that support problem-solving transfer – that is, being able to use what is learned to solve new problems. In each of the next eight chapters, we examine a generative learning strategy – summarizing the material in one’s own words, translating the text into a spatial representation, creating a drawing that corresponds to the text, imagining illustrations that correspond to the presented text, taking practice tests on the material, explaining the material to oneself, teaching the material to others, and acting out the material. In each chapter, we provide a definition and concrete examples of the learning strategy, review the research literature to gauge the effectiveness of the strategy in promoting test performance, summarize the boundary conditions under which the strategy is most effective, and offer theoretical and practical implications as well as suggestions for future work. The final chapter summarizes the eight ways of helping people learn, compares them, and suggests additional techniques for priming generative learning in students.

WHO SHOULD READ THIS BOOK?

This book is intended for anyone who is interested in taking an evidence-based approach to improving how people learn, including learning in K–12 education, college education, and workplace training. The intended audience includes students in undergraduate or graduate courses in educational psychology and related fields, researchers interested in educational psychology and related fields, instructional designers tasked with developing instructional materials, educators interested in improving student achievement based on research evidence, and the general public. The book does not assume that you possess any prerequisite expertise in educational psychology.

Cambridge University Press
978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding
Logan Fiorella and Richard E. Mayer
Frontmatter
[More information](#)

HOW IS THIS BOOK DIFFERENT?

This book is not in competition with educational psychology textbooks but can be used to complement them by focusing specifically on effective learning strategies. The book is not in competition with comprehensive handbooks in educational psychology (such as *Handbook of Research on Learning and Instruction* by Richard Mayer and Patricia Alexander; *The APA Educational Psychology Handbook* by Karen Harris, Steve Graham, and Tim Urdan; or *The Handbook of Educational Psychology* by Patricia Alexander and Philip Winne), but can be used to complement them by providing a more focused and coherent review of research on learning strategies. The book has some similarity to *Visible Learning* by John Hattie or *The International Guide to Student Achievement* by John Hattie and Eric Anderman, but is much more focused, concise, and coherent in its review of what works in improving student learning with learning strategies. Overall, there is nothing quite like this little book on the market, which provides you with a concise review of the eight most effective learning strategies that have been shown to improve student achievement.

Cambridge University Press

978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding

Logan Fiorella and Richard E. Mayer

Frontmatter

[More information](#)

Cambridge University Press
978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding
Logan Fiorella and Richard E. Mayer
Frontmatter
[More information](#)

ACKNOWLEDGMENTS

We are grateful to our colleagues who have stimulated our interest in improving student learning, and we appreciate all those who have contributed to the research base reported in this book. In particular, we acknowledge the towering contribution of Merlin C. Wittrock, to whom we dedicate this book.

We appreciate the many useful comments from our colleagues who graciously reviewed chapters: Ken Kiewra, Claudia Leopold, Detlev Leutner, Scott Marley, Mark McDaniel, Alexander Renkl, and Rodney Roscoe.

Logan Fiorella wishes to thank his parents, Nick and Sharon, for their lifelong guidance and encouragement; and his fiancée Deborah Barany, for her enduring love and support.

Richard E. Mayer wishes to thank his wife, Beverly, for her unwavering support and for making life sweet; his children, Ken, Dave, and Sarah, and his grandchildren, Jacob, Avery, James, Emma, and Caleb, for bringing much joy; and his parents, James and Bernis, who are in his thoughts.

We also acknowledge David Repetto and the helpful staff at Cambridge University Press for all their assistance throughout this project. Preparation of this book was supported by a grant from the Office of Naval Research.

Logan Fiorella and Richard E. Mayer

Santa Barbara, California

Cambridge University Press

978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding

Logan Fiorella and Richard E. Mayer

Frontmatter

[More information](#)

Cambridge University Press

978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding

Logan Fiorella and Richard E. Mayer

Frontmatter

[More information](#)

ABOUT THE AUTHORS

Logan Fiorella is a doctoral candidate in psychology at the University of California, Santa Barbara (UCSB). His research interests are in identifying learning and instructional strategies that promote meaningful learning, with a focus on enhancing science education. He is a winner of the Junior Scientist Fellowship from the American Psychological Association of Graduate Students (APAGS) and Psi Chi, and the Basic Psychological Science Research Grant from APAGS. Recently, he received UCSB's Award for Outstanding Research Contribution in Psychology for his research investigating the cognitive mechanisms underlying learning by teaching.

Richard E. Mayer is Professor of Psychology at UCSB, where he has served since 1975. His research interests are in applying the science of learning to education, with a focus on multimedia learning. He served as president of Division 15 (Educational Psychology) of the American Psychological Association and vice president of the American Educational Research Association for Division C (Learning and Instruction). He is the winner of the Thorndike Award for career achievement in educational psychology, the Scribner Award for career research in learning and instruction, and the Distinguished Contribution of Applications of Psychology to Education and Training Award. He is ranked as the most productive educational psychologist in the world in *Contemporary Educational Psychology*. He has served as principal investigator (PI) or co-PI on more than thirty grants, including recent grants from the Institute of Education Sciences to investigate the effectiveness of features of an online tutoring system and from the Office of Naval Research to investigate how to improve the effectiveness of educational games. He is former editor of *Educational Psychologist* and former co-editor of *Instructional Science*, and he serves on the editorial boards of twelve journals mainly covering educational psychology. He is the author of

Cambridge University Press
978-1-107-06991-6 - Learning as a Generative Activity: Eight Learning
Strategies that Promote Understanding
Logan Fiorella and Richard E. Mayer
Frontmatter
[More information](#)

xvi

About the Authors

more than five hundred publications, including thirty books, among them *Applying the Science of Learning*, *e-Learning and the Science of Instruction* (with R. Clark), *Multimedia Learning*, *Learning and Instruction*, *Computer Games for Learning*, *Handbook of Research on Learning and Instruction* (co-edited with P. Alexander), and *The Cambridge Handbook of Multimedia Learning* (editor).