

2nd Edition

How Learning Works

8 Research-Based Principles
for Smart Teaching

Marsha C. Lovett
Michael W. Bridges
Michele DiPietro
Susan A. Ambrose
Marie K. Norman

Foreword by Richard E. Mayer

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Praise for *How Learning Works*, 2e

“Since the publication of the original *How Learning Works*, I have returned again and again to its thorough and readable summaries of the most important research on student learning. This second edition has become an even more essential resource for faculty, as the authors have infused the book’s recommendations with greater awareness of the social, emotional, and cultural factors that impact student identity and development.”

—**James Lang**, author of *Small Teaching*

“*How Learning Works* is a poignant and provocative book that engages meaningfully and intentionally with the intellectual and affective dimensions of teaching and learning that shape our complex and diverse higher education classrooms. Presenting a well-researched, relevant, and socially conscious range of cognitive and social principles and practices, the authors explore what it means to engage intentionally with students as whole beings, in a socially just, inclusive, and pedagogically responsible way.”

—**Kasturi Behari-Leak**, dean of the Centre for Higher Education Development, University of Cape Town

“The Second Edition of *How We Learn* is superb. I particularly admire its breadth of coverage, which includes socioemotional and cognitive components of learning. I highly recommend it for anyone at any level in education.”

—**Henry L. Roediger, III**, James S. McDonnell Professor of Psychology; Washington University in St. Louis; coauthor of *Make It Stick: The Science of Successful Learning*

“*How Learning Works* is the essential book on teaching and learning in higher education. The new edition is even better than the original. Drawing deeply on recent research to outline eight principles of how learning works, the authors provide practical guidance to put those principles into action. This book is smart, useful, and inspiring!”

—**Peter Felten**, executive director, Center for Engaged Learning, Elon University

“This book provides tremendous benefits to anyone who wants to engage students and facilitate learning in a higher education context. The authors have pruned the extensive research about how learning works into eight principles and their associated implications. Each chapter contains relatable challenges and offers evidence-based approaches for addressing them.”

—**Bonni Stachowiak**, host + producer,
“Teaching in Higher Ed” Podcast

“*How Learning Works* is the perfect title for this excellent book. Drawing upon new research in psychology, education, and cognitive science, the authors have demystified a complex topic into clear explanations of eight powerful learning principles. Full of great ideas and practical suggestions, all based on solid research evidence, this book is essential reading for instructors at all levels who wish to improve their students’ learning.”

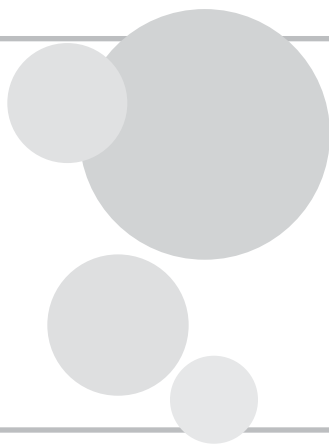
—**Barbara Gross Davis**, assistant vice chancellor for
educational development, University of California, Berkeley,
and author, *Tools for Teaching*

“As you read about each of the eight basic learning principles in this book, you will find advice that is grounded in learning theory, based on research evidence, relevant to college teaching, and easy to understand. The authors have extensive knowledge and experience in applying the science of learning to college teaching, and they graciously share it with you in this organized and readable book.”

—**Richard E. Mayer**, professor of psychology,
University of California, Santa Barbara; coauthor,
e-Learning and the Science of Instruction; author, *Multimedia Learning*

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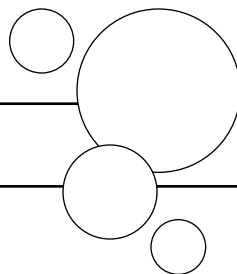
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*To faculty and instructors around the world,
whose dedication to student learning
continues to inspire us.*

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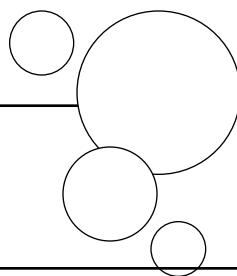


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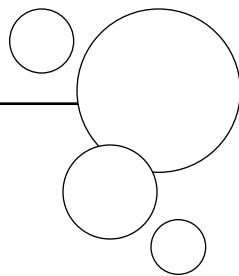
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FOREWORD TO THE FIRST EDITION: APPLYING THE SCIENCE OF LEARNING TO COLLEGE TEACHING



In 1899, the famous American psychologist William James published a little book called *Talks to Teachers*, in which he sought to explain how to apply psychology to education—that is, he sought to use what he called “the science of the mind’s workings” to generate practical advice for classroom teachers. At the time, the book was not much of a success, largely for two reasons: (1) there was a lack of research evidence on how learning works (i.e., the science of learning) and (2) there was a lack of research-based principles concerning how to help people learn (i.e., the science of instruction).

Much has happened in the learning sciences in the past 100 years, particularly in the last few decades. We finally have the makings of a research-based theory of how people learn that is educationally relevant (i.e., the science of learning) and a set of evidence-based principles for how to help people learn that is grounded in cognitive theory (i.e., the science of instruction). Indeed, these are exciting times if you are interested in fulfilling William James’s mission of applying the science of learning to education.

The book you are holding—*How Learning Works: Seven Research-Based Principles for Smart Teaching*—is the latest advancement in the continuing task of applying the science of learning to education—particularly, college teaching. The authors are experts in helping college teachers understand how research in the science of learning can improve their teaching. If you are interested in what research in the science of learning and instruction has to say for you as a college teacher, then this book is for you.

The book is organized on seven learning principles—each a gem that is based on research evidence from the science of learning and the science of instruction.

The principles concern the role of the student's prior knowledge, motivation, and developmental level, as well as opportunities for the student to practice, receive feedback, and learn to become a self-directed learner. Each chapter focuses on one of the principles, such as "Students' prior knowledge can help or hinder learning." Each chapter begins with a concrete scenario in college teaching that exemplifies the principle being highlighted in the chapter, provides a clear statement and rationale for the principle, summarizes the underlying research and its implications, and offers specific advice on how to apply the principle.

Consider the following scenario: You are teaching a course in your field. Based on years of study and work, you are an expert in your field—but you are certainly not an expert in how to teach others about your field. In fact, you have almost no training in how to teach. Yet a fundamental part of your job involves college teaching. You have devised a teaching style that works for you, but you wonder whether there is any way to base what you are doing on scientific principles of learning and teaching. This description fits many college teachers.

The book you are holding is based on the idea that you wish to consider taking an evidence-based approach to college teaching—that is, you wish to inform your instructional decisions with research evidence and research-based theory. Why should you take an evidence-based approach? You could base your instructional choices on fads, ideology, opinions, expert advice, or habit—but these approaches may not be ideal if your goal is to be an effective teacher. Admittedly, advice from experts and your own personal experience can be useful aids to you in planning instruction, but they may be incomplete. In taking an evidence-based approach, you seek to add to your knowledge base by discovering what works and how it works. In short, it is helpful to understand what the science of learning has to offer you in your role as a college teacher.

Where should you look for help in improving your college teaching? Consider three common choices:

Sources that are too hard: You could try to digest research articles in the field of learning and instruction, but you might find them somewhat tedious and perhaps daunting. This approach is too hard because it focuses on scientific evidence without much focus on how to apply the evidence to teaching.

Sources that are too soft: You could read self-help guides that offer practical advice that is not necessarily based on research evidence or research-based theory. This approach is too soft because it focuses on practical advice without supporting evidence or theory to back up the advice.

Sources that are just right: You could read this book, which synthesizes empirical research evidence and research-based learning theory into practical advice for how to improve your college teaching. In short, the strength of this book is that it combines research evidence and practical advice to produce an evidence-based approach to improving your college teaching. If you are interested in what the science of learning has to contribute to your college teaching, then this book is for you.

What should you look for in this book? In reading this book, I suggest that you look to make sure that it meets four basic criteria for applying the science of learning to your college teaching:

Theory-grounded: the advice is grounded in a research-based theory of how people learn.

Evidence-based: the advice is supported by empirical research evidence showing how to help people learn.

Relevant: the advice has clear and practical implications for how to improve your teaching.

Clear: the advice is understandable, concrete, and concise.

As you read about each of the seven basic learning principles in this book, you will find advice that is grounded in learning theory, based on research evidence, relevant to college teaching, and easy to understand. The authors have extensive knowledge and experience in applying the science of learning to college teaching, and they graciously share it with you in this organized and readable book.

I congratulate you for your interest in improving your teaching and commend you for taking the important step of reading this book. If you want to improve your teaching, it is useful to understand what research says about how learning works and about how to foster learning. In light of these goals, I welcome you to the feast of evidence-based advice you will find in this volume.

Richard E. Mayer
University of California, Santa Barbara



ACKNOWLEDGMENTS

Creating the second edition of *How Learning Works* involved significant time and effort—not only on our part as coauthors but also from friends and colleagues who made extremely important contributions along the way. First, we would like to thank our educational development colleagues, Victoria Genetin (from the University of Michigan) as well as Phoebe Cook and Janet Lawler (from Carnegie Mellon University), for providing thoughtful and perceptive comments on our revised chapter drafts. The text was markedly improved as a result of their thorough reviews. We also thank Michelle Pierson for her assistance with copyediting the new manuscript and for the painstaking work of checking and properly formatting references.

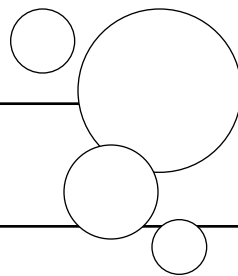
Readers familiar with the original edition of *How Learning Works* are sure to have benefited from the conceptually helpful and visually attractive figures throughout the book (not to mention the striking cover). All of these visuals were created by our talented colleague Judy Brooks, who was willing to collaborate with us again on the second edition—creating new figures (for the new Chapter 1 and overhauled Chapter 7), enhancing several original figures to be more crisp and clear, and updating the full set to be stylistically coordinated. As ever, we are deeply grateful for Judy's expertise in design, her thoughtful approach to the learning principles at hand, and her artful creativity in depicting them so effectively. We also love the new cover—how it connects with but stands apart from the first edition's. And most of all, we appreciate the great conversations about the principles that were sparked by Judy's incisive questions and inspiring design ideas!

To the many friends and colleagues who contributed to the first edition, we reiterate our sincere thanks and acknowledge that the indelible mark of their

comments, suggestions, and ideas are carried forward in the current edition. These thanks go to Anne Fay for her early contributions to the first edition, which shaped the principles and the research reported, to Aimee Kane for her thoughtful and reflective feedback later in that process, and to Lisa Ritter for careful attention and exacting standards as she served in the role of internal editor by copyediting the original manuscript. We are also thankful for an outstanding set of colleagues, at Carnegie Mellon and other universities in the United States and abroad, who were willing to take time from their busy schedules to read and provide insightful feedback on different chapters from the first edition. These colleagues include Vincent Alevan, Ryan Baker, Rebecca Freeland, Scott Kauffman, Edmund Ko, Ken Koedinger, Norma Ming, Matt Ouellett, Ido Roll, and Christian Schunn.

Finally, we would never have embarked on this entire endeavor in the first place if it were not for the thousands of faculty members and graduate students with whom we have worked over the years. We are humbled by your ongoing dedication to your students and by your willingness to share your stories and experiences, open up your courses to us, and reflect thoughtfully on and refine your teaching practice. We continue to learn and benefit from our interactions with you, and we hope this book provides something useful in return.

ABOUT THE AUTHORS



Marsha C. Lovett is vice provost for teaching and learning innovation at Carnegie Mellon University (CMU). In addition, she is director of CMU's Eberly Center for Teaching Excellence & Educational Innovation and a teaching professor in the Department of Psychology. Marsha leads a team of teaching consultants, learning engineers, designers, data scientists, and technologists to help instructors create meaningful and demonstrably effective educational experiences—for in-person, hybrid, and online learning. She received her doctorate in cognitive psychology from CMU and spent a year as a visiting scholar in the Graduate School of Education at the University of California, Berkeley. Marsha has taught a variety of courses—from introductory cognitive psychology to graduate research methods—and one of her favorite teaching memories is a seminar on human expertise that included students juggling, playing poker, and sharing cooking techniques. Marsha has studied learning in the laboratory and the classroom, leading to more than 50 articles on learning and instruction. She has presented workshops, keynotes, and invited talks across the United States and abroad. Marsha has also created several innovative, educational technologies to promote student learning and metacognition, and she has developed and/or evaluated online courses in the sciences, social sciences, and humanities. Marsha is happiest when she is working with educators to collect qualitative and quantitative data in their own courses and then leverage the results to enhance students' learning outcomes and sense of belonging.

Michael W. Bridges is executive director of the University Center for Teaching and Learning (UCTL) at the University of Pittsburgh. In this role, he leads the university's efforts to create exceptional and consequential learning experiences. Toward this goal he directs and works with a large team of

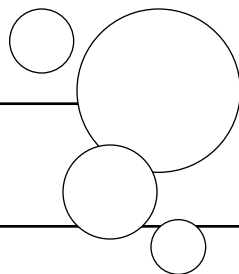
instructional designers, teaching consultants, educational technologists, learning space designers, and assessment experts to support excellent teaching. Mike received his doctorate in social psychology from Carnegie Mellon University in 1997. His early career focused on understanding the role of psychosocial variables in recovery from coronary artery bypass surgery and breast cancer. He formerly served as the vice president for educational strategy and excellence at iCarnegie Global Learning, where he used the principles in this book to help instructors in Russia, Kazakhstan, India, Mexico, Colombia, and Qatar to design, develop, and deliver great courses. Mike has more than 30 years of teaching experience and still feels a mixture of anxiety and excitement on the first day of every class. His most recent interests focus on understanding the role of narratives in teaching and the unending quest for a recipe for perfect falafel.

Michele DiPietro is the executive director for faculty development, recognition, and the Center for Excellence in Teaching and Learning (CETL) and a professor in the School of Data Science and Analytics at Kennesaw State University. As executive director of CETL, Michele oversees university-wide faculty and graduate student development efforts, both in pedagogy and career and leadership development. They received their doctorate in statistics from Carnegie Mellon University in 2001. Their scholarly interests include the application of learning sciences to enhance college teaching, holistic faculty development, inclusion and justice in the classroom, teaching in times of tragedies, and more. Michele practices “shine theory,” helping educators and administrators shine bright and find fulfillment in their work so that they might help their students shine. Michele has served as president of the POD Network in Higher Education, the premiere educational development organization in North America, and as a board member of the International Consortium for Educational Development. Their first year seminar “The Statistics of Sexual Orientation” has been featured in a variety of media, including *The Chronicle of Higher Education*. Michele is the recipient of the Bob Pierleoni Spirit of POD award, the highest award bestowed by the POD Network for professional achievement and legacy to the field.

Marie K. Norman is associate professor of medicine and clinical and translational science at the University of Pittsburgh. She is director of the Innovative Design for Education and Assessment (IDEA) Lab, where she leads hybrid and online educational initiatives for the Institute for Clinical Research Education (ICRE). She is also co-director of the Team Science Core of the Clinical and Translational Science Institute. Marie received her doctorate in cultural anthropology from the University of Pittsburgh and conducted her fieldwork in Nepal,

funded by a Fulbright award. Her first love is teaching, and she is proud to have taught in higher education for more than 25 years, first in undergraduate and now in graduate education, teaching a wide range of courses, seminars, and workshops on topics from anthropology to leadership to team science to adult learning theory. She also brings experience from the business world, having served as director of intercultural education at iCarnegie Global Learning and senior director for educational excellence at Acatar, an educational technology start-up. Marie has been fortunate to work with educators in Colombia, Kazakhstan, Tatarstan, and Qatar, sharing the principles from this book and learning from their expertise. She has been closely involved in a number of diversity, equity, and inclusion initiatives, serving on the ICRE's Diversity Advisory Committee and helping to develop and administer the LEADS, PROMISED, Building Up, and TRANSFORM programs for scientists from underrepresented backgrounds. She is happiest working in collaboration with smart, curious, socially engaged people on projects at the intersections of teaching, learning, culture, technology, and design.

PREFACE TO THE SECOND EDITION



When we wrote the first edition of this book, we all lived in the same mid-sized city in the Mid-Atlantic and worked at the same institution, a mid-sized university with a reputation for excellence in technical and creative fields. A lot of *mids*, in other words. Since then, a great deal has changed, not only in the world and in higher education but also in our own lives.

Michele became the director of a teaching center at a southern state university, considerably less resourced than what they had been used to, making strides in spite of those conditions but grappling with issues of salary compression and sometimes even salary inversion. The demographic makeup of the student body was much more diverse, with social attitudes spanning the full political spectrum. Class sizes were large and teaching assistants scarce, and faculty members struggled to put recommended teaching strategies into practice, simply because the administrative and grading burdens were too great. Michele encountered undocumented students and students living in poverty and began to better appreciate the precarity of their lives and its effect on their studies: students who had to skip class to avoid a police roadblock or make a court appearance, for instance. While the students were bright and dedicated, a few included veterans grappling with PTSD and students whose previous education was so insufficient they could not manage college classes. Through rapidly changing institutional leadership, Michele's campus made the national news multiple times over controversies about free speech and accusations of racism. A state law allowing guns in unrestricted areas of campus raised safety concerns for educators who taught controversial subjects. Long interested in yoga, Michele began to integrate their yoga practice into their work to foster a more compassionate, holistic, and radical approach to supporting faculty.

Marsha stayed at the university where we all first met, but she moved into new administrative roles and collaborations. Many of these collaborations focused on the intersections of learning and technology, specifically the uses of

learning analytics. She developed several novel technologies to enhance students' learning and metacognition. At the same time, her personal experiences with faculty and students from different backgrounds shifted her outlook on teaching and learning. She encountered students who, despite attending an elite institution, regularly confronted food insecurity. She witnessed colleagues with disabilities, trans colleagues, and colleagues from minoritized groups navigating the entrenched hierarchies and rigid norms of institutions that were not designed for them, and in fact were sometimes openly rejecting. When she read the results of a qualitative study of students' experiences related to diversity and inclusion on her campus, she found the stories painful to read.

Meanwhile, Mike and Marie moved out of academia (temporarily) and into the business world, working together at a global education start-up. Their positions took them overseas to countries from Kazakhstan to India to Colombia and gave them a deep appreciation for the ways in which education and culture—not to mention politics and economics—are intertwined. Their work also introduced them to the fast-paced, competitive culture of business, which is so strikingly different from academia. In the process, they learned communication and marketing skills that are relevant to teaching and learning yet rarely part of academic training. Eventually, both found their way back to academia.

Marie joined the faculty in a school of medicine, coming to better appreciate the needs of adult learners in professional schools as well as the different forms of teaching that characterize clinical preceptorship, mentorship, and even team science. Her involvement in collaborations with Minority Serving Institutions and Hispanic and Native American Centers of Excellence disrupted her assumptions about how different institutions and institutional cultures operate and widened her understanding of the issues facing faculty members and students from different backgrounds. At the same time, she became deeply involved in online program development and the factors that make for engaging, rigorous, and creative online learning.

Mike returned to academia as an administrator, leading online education and faculty development initiatives at several universities, each with a distinctive institutional flavor. Guiding institutional strategy and working with a large, diverse staff widened his understanding of the roles and responsibilities of institutions of higher ed. At the same time, watching his own child progress through the school system and learn new skills, both academic and non-academic, has made him appreciate learning—and the learning principles featured in this book—in new ways.

At the same time, the world changed radically around us and higher education itself shifted in seismic ways. Demographic changes—a shrinking pool of college-aged students and population shifts to the southern and western parts of the country—left many institutions of higher education scrambling for students. To attract applicants, many doubled down in an arms race of campus amenities, sometimes to the detriment of academics. Some colleges and universities, unable to compete, folded. Greater ideological division in the country prompted more scrutiny of academic institutions through state boards of regents and other oversight agents. Declining state educational budgets led public institutions to tighten their belts, replacing tenure-track faculty with less-expensive adjuncts, increasing class sizes, and cutting programs. Competition from industry and alternate forms of training and credentialing forced academia to develop new business models and offerings, including “unbundled” degree programs, massive open online courses (MOOCs), micro-credentials, bootcamps, continuing and professional education units, and programs to engage alumni under the banner of “lifelong learning.” New technologies entered (and left) the scene, changing the way instruction was delivered as well as the pressures on faculty. The rise of online programs brought new ways to reach students but with them a host of new challenges, both pedagogical and administrative.

And, of course, COVID-19 rocked higher education. As fears of the virus intensified, institutions closed their physical facilities and sent students home. Courses moved suddenly to remote delivery, only to move back to the physical classroom, then back online based on the shifting public health situation. Administrators, faculty members, and students learned to pivot quickly to keep up, developing more agility than they knew they had. But as students joined classes from home, universities struggled to justify their high cost and maintain relevance. A slew of questions arose: Would higher education remain online? What would this mean in terms of inclusion and access? Were physical campuses and in-person learning even necessary? What could universities offer that justified the increasingly high cost of a degree?

The murder of George Floyd, Breonna Taylor, and so many others at the hands of police brought to the surface a long overdue racial reckoning. The aftermath has left many institutions interrogating the role they should play in a modern democracy, and committing to dismantling structural bias and injustice more intentionally (and, one would hope, sincerely). Diversity, equity, and inclusion initiatives became more extensive and sophisticated. The #MeToo movement sparked deeper conversations about gender and power, and a nationwide

explosion of interest in more fluid expressions of gender and sexual identity changed the conversation on college campuses—with a subsequent backlash. At the same time, the country saw the proliferation of misinformation, disinformation, and conspiracy theories. We saw verifiable facts discounted as “fake news,” accuracy devalued in favor of personal opinion, and fabrications legitimized under the guise of free speech. As some legislatures capitalized on the confusion and fear of the moment to dictate what could and could not be taught in public universities, educators struggled with the assault on academic freedom and mourned what often felt like a loss of meaning in their work. Students and their families, for their part, have been buffeted by the turmoil, left with spiraling student debt from the rising cost of higher education, and a growing sense of cynicism about the cost of education relative to its value.

Throughout these social shifts—and sometimes in direct response to them—the research on learning evolved, providing empirical evidence where there were once just anecdotes and hunches, debunking long-standing assumptions about teaching and learning, and expanding into new areas of inquiry. The terminology of learning research—cognitive load, social presence, stereotype threat, growth mindset—moved into the mainstream, although many lessons from the learning sciences have yet to make their way into classroom practice.

The sum of these changes—in our own lives, the larger landscape, and the learning sciences—prompted our decision to rethink *How Learning Works*. To be clear, we are immensely proud of the first edition; however, we are not blind to its limitations. While we had aimed to be research-based, the research we referenced was, understandably, only in English. The studies we included were conducted largely with traditional-aged college students and not the broad population of students attending colleges and universities today. Our cases and strategies were predicated on our own experience teaching at an elite university. Indeed, the very definition of learning we used was steeped in Western thought and embedded in the cultural currents of the early 2000s. We were not fully cognizant then of how fully our perspectives were shaped and constrained by our cultural, linguistic, and institutional context. We are more so now.

So it is time for an update.

We have made significant changes in the second edition. Most notably, we have expanded from seven to eight principles, which has enabled us to delve more deeply into the social and emotional components of learning. A brand-new chapter (Chapter 1) explores individual differences among learners, and the intersections of identities and backgrounds that shape how students enter, respond to,

and shape the learning environment. A reworked chapter (Chapter 7) investigates more fully the ways that instructors can shape the climate of their courses to make students feel included or marginalized—and the implications for learning and performance. Across all eight principles, we updated the research previously discussed while integrating new areas of research. Wherever possible, we applied a diversity, equity, and inclusion lens, exploring issues of power, identity, and belonging as they relate to teaching and learning. We have also referenced a broader range of institution types and student populations than in the previous edition and incorporated case studies and strategies relevant to emerging educational technologies and online and hybrid learning modalities.

As we have worked together, comparing notes from our experiences since writing the first edition, we have rediscovered how enduring the principles elaborated here are. They have proven to be as relevant in skill-oriented professional schools as they are in highly theoretical undergraduate courses, as applicable in large classes as in small, as important online as in person. Moreover, when we have presented the principles in our travels around the world, they have always resonated with our audiences. So much so, in fact, that *How Learning Works* has been translated into Arabic, Chinese, Japanese, Korean, Italian, and Spanish. We cherish the fact that our work is being used to spark conversations about teaching and learning around the world.

In closing

One of the great joys of writing the second edition of this book was the opportunity for the four of us to reconnect with one another and reignite a collaboration we value deeply. Our original coauthor, Susan A. Ambrose has since retired and did not rejoin the effort. But the fun we had working together this time reminded us of the fun we had the first time.

We hope you enjoy the second edition of *How Learning Works* as much as we enjoyed writing it.

Marsha, Michele, Mike, and Marie

