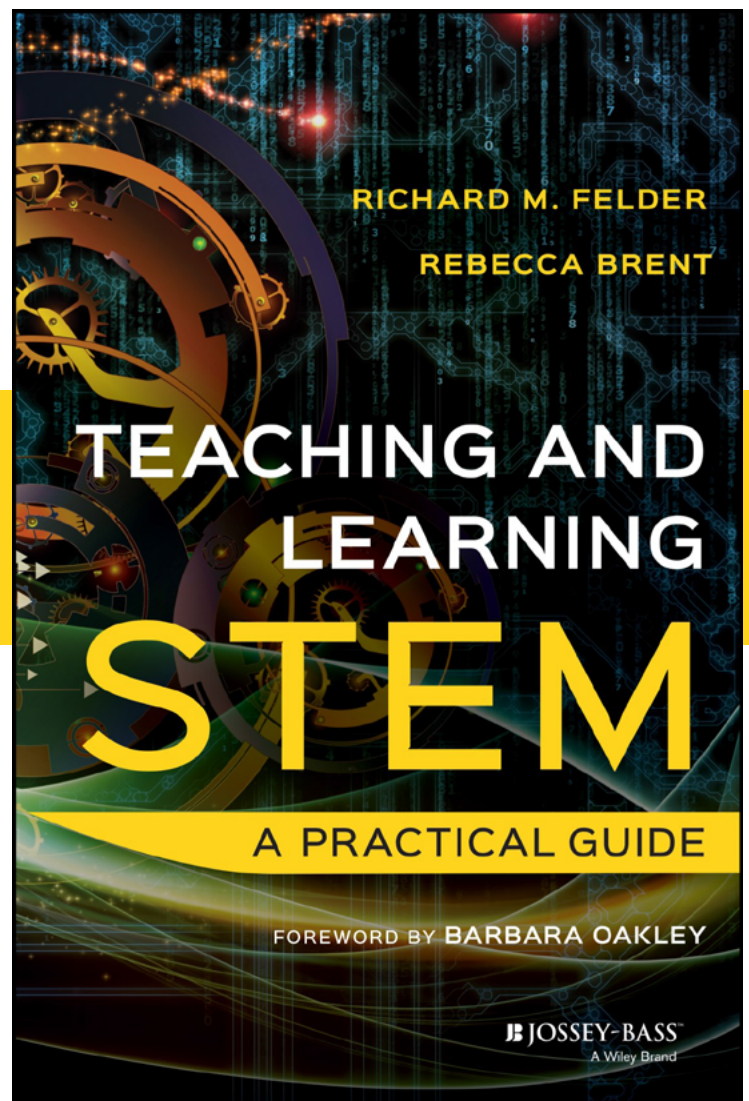


Rethink traditional teaching methods to improve learning and retention

Richard M. Felder
& Rebecca Brent

Educational research has repeatedly shown that compared to traditional teacher-centered instruction, certain learner-centered methods lead to improved learning outcomes, greater development of critical high-level skills, and increased retention in science, technology, engineering, and mathematics (STEM) disciplines.

Teaching and Learning STEM presents a trove of practical research-based strategies for designing and teaching courses and assessing students' learning. The book draws on the authors' extensive backgrounds and decades of experience in STEM education and faculty development. Its engaging and well-illustrated descriptions will equip you to implement the strategies in your courses and to deal effectively with problems (including student resistance) that might occur in the implementation.



"Felder and Brent, longtime leaders in STEM education research, fill an important gap by providing both insightful and very practical guidance for the college instructor trying to translate the findings of STEM research into effective classroom practice."

—**Carl Wieman**, Noble Laureate in Physics,
Department of Physics and Graduate School
of Education, Stanford University

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Review

Teaching and Learning STEM: A Practical Guide by Dr. Richard Felder and Dr. Rebecca Brent by Kenneth Reid

Teaching and Learning STEM: A Practical Guide by Dr. Richard Felder and Dr. Rebecca Brent begins with this observation: “Skilled professionals routinely receive training before being certified to practice independently. . . . It would be unthinkable to allow people to practice a skilled profession without first being trained for it, especially if their mistakes could cause harm to others — unless they are college faculty members.” Perhaps you had not considered this possibility; but, if you are a STEM teacher, you were likely taught by teachers and professors that had little to no training in educating. Is it possible that even esteemed faculty from leading institutions who conduct groundbreaking research simply teach as they have been taught? Some in academia might argue that, since they made it through and earned their degree, this method must be effective; therefore, continuing the tradition is appropriate. However, anyone who has had a class taught by an ineffective or disinterested professor, or anyone who enters academia as a new, energetic faculty member only to hear a message that teaching isn’t important or valued knows that this is a disservice to the students — and to the faculty member.

I recall preparing to enter my classroom for the first time as an adjunct instructor years ago, and thinking of the few courses I enjoyed (and a few that were awful). I thought about the good courses — what made them work? I remember the courses where we tried things instead of simply listening, courses where we knew what we were supposed to do, and courses where the instructor was dynamic. I had the opportunity to attend a workshop with Drs. Felder and Brent early in my career, and had an epiphany. The classroom qualities I valued as a student were not flukes; they had names (active learning and comprehensive learning objectives, for example) and that professors who appreciated the role of a teacher could enjoy teaching. With comparable preparation time and a willingness to do things differently, my students would benefit; and I would be more effective.

Drs. Felder and Brent built upon this workshop and have written a book that should be required reading for new faculty — and not-so-new faculty. One of the strengths of the book is found in How to use this book: “Instead of reading this book as a novel, use it like a reference work.” Take the book out at the beginning of each course you teach, look through a section you haven’t read recently, and find and try a new idea. The goal is to present proven teaching methods (built upon a foundation of research and experience) and prepare the instructor to implement those methods. The foundation of solid research should certainly appeal to journal readers.

The book works on many levels, one of which is the

new professor. Helpful hints give permission and guidance to seek help from colleagues rather than reinventing the wheel (or, in this case, the syllabus and class materials). It’s also for the professor in mid-career — around the typical timeline for tenure: the guidance can help in those cases where one may have stagnated or began to coast. I believe an ideal audience would be the experienced professor — past tenure, perhaps having taught a course enough that their autopilot is engaged. Before the semester, hunker down and look at a section or two. You will do yourself AND your students a favor. Another is the graduate teaching assistant. GTAs often have no training at all before they hit the classroom, and need to hit the ground running. This book can be their guide. In fact, it could be considered as a textbook for a teaching practicum course, but it is probably most valuable as a reference.

The book is broken into sections: not only is this helpful to parse the information, it helps to decide which area to attack first.

The strength of Part I: Designing Courses is the blend of solid advice with research- and experience-based evidence supporting the ideas. The words come as though from a trusted mentor, offering support. The necessity of defining effective course objectives is discussed, and guidance on defining these objectives is presented. Planning your courses, including designing an effective syllabus, grading policy and testing prerequisite knowledge: it’s all here. For a moment, stop and consider a topic in your course, and think, from the student’s perspective; how do they know if they have met the objective. If the objective for a section of the course is given as “understand how to use mesh analysis” vs. “use mesh analysis to find currents through each branch of a circuit containing voltage sources and resistors,” can a student feel confident that they have met the objective? From the instructor’s view, if a student can demonstrate meeting the second objective, have they adequately demonstrated they could meet the ‘understand’ objective? Specifying objectives that are clear and observable not only help the student, but help you as the instructor who will assess the student’s performance.

Part II: Teaching Courses looks at elements of effective instruction and how to manage your class. This section should appeal to the instructor who finds themselves spending hour after hour (after hour) preparing and perfecting the lesson, only to be met with the glazed-over glances from students. If nothing else, the first section, “Elements of Effective Instruction,” could be an effective book on its own — as it thoroughly covers a lot of ground. It ends with “Ideas to take away” as does each major section; an excellent place to rest a bookmark. Periodically,

pull the book off the shelf and flip through the ‘ideas’ for a fresh approach or a dose of encouragement. The section continues through active learning, classroom technology and evaluation of learning — each topic discussed in practical terms with research- and experience-based, rock-solid advice.

Part III: Facilitating Skill Development discusses ideas for development in key areas; it goes more in-depth into professional and critical thinking skills, complex problem solving and goes into quite a bit of detail on teaming. This section proves extremely useful for most if not all of us who have formed teams. Consider these questions: how many students should be on a team? How should a team be formed to give students their best chance of success? Should teams be dissolved or shuffled, or should teams last the entire term? Although we have generally faced these questions before, the tone and content feel like a welcome conversation from a knowledgeable colleague.

The reader will find interludes featuring “Meet your Students” and “Good Cop / Bad Cop,” which, in a way, take advantage of the shorter-than-expected attention span of the student (6 minutes in lecture mode). While these effectively help break the content into digestible portions, each offers a scenario illustrating a real-life application of a concept. Further, ending each section with “Try This in Your Course” and “Ideas to Take Away” allows you to use your post-its and highlighter efficiently and effectively.

Certainly, this all sounds good, but does it really work? Since my initial experience in a workshop with Drs. Felder and Brent, I’ve attended more workshops, and read the research to support classroom innovation. I have 20+ years of experience teaching at all levels. While it is a lot of experience, it is enough to understand that nobody knows it all, and everyone can improve. Although I picked up this book to review, I now find my copy of this book is highlighted, notes are in the margins and multiple post-it tabs peek out from the edges. I find myself with a renewed sense of excitement and a few ideas I intend to implement. I read the book to review it, but instead, find myself with ideas and a renewed appreciation of being in the classroom: I found myself learning.

Kenneth Reid is the Assistant Department Head for Undergraduate Programs in Engineering Education at Virginia Tech. He earned his PhD in Engineering Education in 2009. He and his coauthors were awarded the William Elgin Wickenden award for 2014, recognizing the best paper in the Journal of Engineering Education and awarded Best Paper, ERM Division of ASEE in 2014. He was awarded an IEEE-USA Professional Achievement Award in 2013 for designing the nation's first BS degree in Engineering Education. He was named NETI Faculty Fellow for 2013-2014, and the Herbert F. Alter Chair of Engineering (Ohio Northern University) in 2010. His research interests include success in first-year engineering, engineering in K-12, and international service and engineering. He is active in engineering within K-12, serving on the TSA Board of Directors. He has written two texts in Digital Electronics, including the text recommended for Project Lead the Way.

