A Review of *Teaching and Learning STEM: A Practical Guide*

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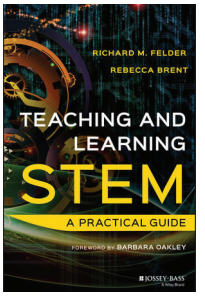
Teaching and Learning STEM: A Practical Guide, by Richard M. Felder and Rebecca Brent, published by Jossey-Bass (March 7, 2016), 336 pages. ISBN-10: 1118925812



The increasing pace of pedagogical research over the past couple decades can easily lead to a predicament: wanting to expand your use of effective, evidence-based teaching methods without knowing how to start or, even worse, feeling like you may need to overhaul everything you do if you start down that path. Felder and Brent reassure us early on that "teaching well does not have to be harder than teaching poorly." In their book *Teaching and Learning STEM: A Practical Guide*, they walk readers through the stages of designing classes, teaching, and developing student skills in STEM courses, offering a wide variety of bite-sized research-based strategies as options.

The book systematically addresses planning and executing an effective class when read cover to cover, but the authors suggest "instead of reading the book like a novel, treat it like a reference work"; indeed, reading a few relevant pages or a chapter will provide focused advice and specific suggestions for things to try in a tone I found conversational and approachable. Each chapter starts with a list of questions before delving in to address them, with most covered briefly, but with enough depth to take away an idea to put into action. Particularly helpful are the end of each chapter sections on "Ideas to Take Away" and "Try This in Your Course," which provide lists that are concrete and useful distillations of the chapter's major points and suggestions.

Most strategies are presented in a general way without application to a specific discipline. When multiple examples are provided, for instance in providing samples of effective learning objectives, they span a variety of STEM fields. Even specific case studies, which may be framed in a chemistry or engineering context, were always sufficiently general that I could easily translate them into my physics classroom.

As a general philosophy, the authors make a strong case for learner-centered teaching and active learning, in which students are actively engaged and their learning (rather than our teaching) is the ultimate measuring stick. Much of the supporting evidence is through extensive prior research by the authors, but citations to a wide range of pedagogical research are included. I found myself continually comparing and contrasting my own teaching, gaining insights along the way as if chatting with a knowledgeable colleague.

The book is divided into three major sections. In the first, **Designing Courses**, chapters on "Learning Objectives," "Planning Courses," and "Planning Class Sessions" walk instructors through the process of developing clear instructional goals and implementing a strategy for students to reach them. Bloom's taxonomy is used to frame learning at different levels and attention is paid to how to get class off to a good start in the first week. Some specific recommendations, such as limiting time spent on class prep, providing study guides for exams, and not curving grades provided thought-provoking perspectives on my current classes.

The second section, **Teaching Courses,** includes chapters on "Elements of Effective Instruction," "Active Learning," "Teaching with Technology," and "Evaluating Knowledge, Skills, and Understanding." In the first of these chapters, Felder and Brent offer ways to get feedback from your class and from colleagues, either as outside observers or models of effective teaching. In the next, a number of active learning strategies are provided, briefly enough to cover a lot of ground while detailed enough to suggest ways to get started, for instance, having students explain worked-out solutions to problems that demonstrate a newly taught strategy or having pairs of students come up with a couple of good questions about the material rather than simply tossing out an offer to answer questions amidst silent, blank stares. One clever technology strategy described is to reward students for finding online resources, which you can then incorporate while teaching the course again. The evaluation chapter includes advice on how to design effective exam questions as well as evaluating other types of assignments, such as lab reports and presentations.

The final section, **Facilitating Skill Development,** includes chapters focused on "Problem Solving," "Professional Skills," and "Teamwork." These are often overlooked but crucial to success in the workplace, in which critical thinking and collaboration are frequently keys to success. Modeling problem solving and metacognition, or using problem-based learning or pair problem-solving strategies can bring the process of working through problems out in the open. These thinking skills lead nicely into developing creative and critical thinking techniques, for instance, by training students to brainstorm or adding an extension to a straightforward problem that asks students to troubleshoot a scenario in which the ideal behavior was not observed. These expand thinking beyond the tunnel vision of simply seeking the right answer. The chapter on teamwork addresses nuts and bolts questions of how to form teams, manage conflicts, and structure cooperative learning, and they provide a compelling case that well-designed group work effectively leverages the group members' efforts and skills.

A final chapter revisiting learner-centered teaching includes discussions of student diversity and a broad overview of inductive teaching strategies. While such a chapter could provide a nice introductory overview of the book, it benefits by referencing the prior chapters and provides a satisfying reflection on the ground that's been covered.

I found myself continually thinking through my approach to current courses as the book truly is the "practical guide" promised in the title. The strength of this book compared to the many others available is the large number of specific strategies geared towards STEM education, many of which could be implemented immediately, described in just enough detail to quickly get started on the *what* and *how* with just enough education research context to motivate the *why.* Readers interested in in-depth presentations of particular strategies, such as

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case-based learning or group work, will likely prefer more extensive and focused resources, but Felder and Brent provide a wide-ranging and practical overview of what's out there.

As I plan my upcoming courses, I intend to refer to this book as I adjust rather than overhaul my approach, continuing along the path of including active learning while I reconsider curving grades, plan more intentional and focused reading assignments, and pose exam questions that ask students to speculate beyond expected behavior. Primarily, the text provided an opportunity to broadly reflect on my existing practice and motivation to continue exploring new teaching tools. Ultimately, *Teaching and Learning STEM: A Practical Guide* did exactly what I would want from such a resource: provided a large number of specific suggestions from which I can draw inspiration and strategies that resonate with me and my current teaching, offered research-based rationales along with thoughtful discussions on how to implement these strategies, and was as easy reading as it was informative.