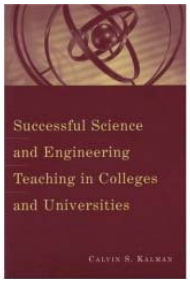
The National Teaching & Learning FORUM




# Successful Science and Engineering Teaching in Colleges and Universities

Calvin S. Kalman, Anker Publishing, 2007

*Reviewed by Gary A. Smith, Office of Support for Effective Teaching, University of New Mexico*

The title of this concise and highly readable book suggests to the reader that they have encountered a handbook of strategies for effective teaching in the SMET disciplines. Instead, Kalman, an accomplished physics professor and science educator at Concordia University in Montreal, summarizes only the approaches that he uses in his physics courses. His teaching and his book focus on two instructional instruments: reflective writing and cooperative/collaborative learning. Two of the ten chapters deal with reflective writing, where students freewrite to explore a concept or piece of writing, such as a section of their textbook. Two other chapters delve into various aspects of group work in class.

Kalman employs reflective writing and group learning as tools to engage student metacognition and conceptual change, respectively. Freewriting about text reading, rather than simply summarizing the text, forces students to make meaning of what they have read and to identify that which they still do not understand. Also important, the reflective writing assignments cause students to make first contact with content prior to coming to class, where group work replaces extended lectures to engage them in meaningful application of the content. Chapters dedicated to epistemological development and conceptual change provide the foundation for understanding Kalman's emphasis on writing and group work. Two additional chapters on assisting students to learn problem-solving strategies link to the group-work theme. A final chapter on computer-assisted instruction refers to the author's early efforts at developing interactive computer-based assignments and not only does not fit with the remainder of the book but provides no insights into current use of computers for learning in SMET classes.

Because the book focuses on Kalman's two well-aligned strategies the reader does not learn about many related approaches to successful science instruction, even in physics. Two strategies are particularly notable for their absence. Just-in-time teaching (Gregor Novak and colleagues) overlaps significantly with Kalman's reflective writing approach but is not mentioned in the book. Also missing is the use of classroom response systems with peer instruction (Eric Mazur), which is an alternative to Kalman's structured groups to develop cooperative learning that addresses misconceptions and is particularly effective in large-enrollment classes. Another drawback of Kalman's emphasis on his own experience is that nearly all of the examples are drawn from first-term physics rather than the wider breadth of science and engineering that is suggested by the title.

One can also ask how Kalman knows that his strategies are successful, since this is the first word in the title. He neither provides data on learning effectiveness in his classes nor does he cite literature that provides quantitative support for these same or comparable learning

strategies. In fact, the catchall phrase "active learning" appears nowhere in the book and the idea of pre- and post-testing to measure learning gains receives brief mention only in terms of concept inventories that demonstrate the failure of traditional instruction to change students misconceptions. For a reader new to non-lecture based instruction it would seem prudent to point out studies such as those by Richard Hake that demonstrate, using the Force Concept Inventory, and the positive impact of active learning approaches of the type advocated by Kalman.

The chapters on conceptual change and epistemological development provide concise, but incomplete introductions to these important topics. Much of Kalman's book, with its focus on metacognition and conceptual change, finds support in the National Research Council reports by John Bransford and colleagues, but these critical studies are never cited. He chooses to discuss Piaget's work in epistemological development but does not include the arguably more relevant and later work by Perry and Baxter Magolda.

The paucity of references or incorporation of supporting ideas is seemingly purposeful, as Kalman states at the onset that the book is "intentionally informal," and viewed "as a discussion of our mutual interest in helping students learn." For those readers who are already familiar with active-learning strategies, Kalman certainly provides valuable insights from his experiences. For those, perhaps skeptical of change, who seek to understand alternatives to lecture-lab-homework instruction I doubt the book will be persuasive because it is much more narrowly focused than the title implies, lacks exposure to a breadth of approaches, is very incomplete in supporting citations, and lacks evidence for why these strategies are known to be successful.

I highly recommend Kalman's book to those SMET instructors who seek to incorporate more writing, especially informal writing, into their courses. The chapters on assisting students to learn how to solve problems should be required reading for all instructors who assign quantitative-problem homework. Kalman also provides some of the most thorough treatment I have read for establishing and managing formalized learning groups. If one wants concise and readable overviews of metacognition, conceptual change, and epistemological development then, with reservation, this book summarizes these concepts extremely well. The reservation is that the incomplete citations can leave the reader unconvinced of the significance of these themes for understanding learning and designing effective teaching.

Table of Contents | Issues | Credits
NTLF.com Home