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Book Reviews

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SCIENTIFIC INNQUIRY AND NATURE OF SCIENCE: IMPLICATIONS FOR TEACHING, LEARNING, AND TEACHER EDUCATION

By L. B. Flick and N. G. Lederman (Eds.)
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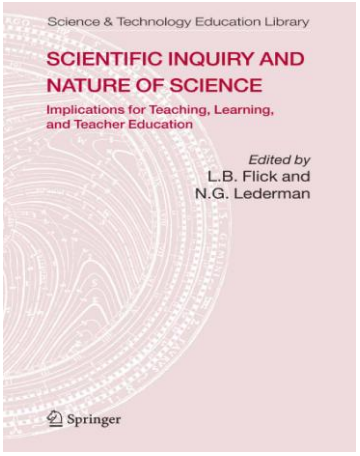

This book addresses an important contemporary question about science education, "How can we change science teaching approaches and assessments in K-16 classrooms during the next century to teach students about inquiry and nature of science?" This book serves to clarify the confusion surrounding the reforms advocating that teachers use new approaches incorporating inquiry and nature of science in science classrooms. In the United States, scientific inquiry and nature of science are two main themes of the national science education reforms, and it is important to take a critical look at how these impact teaching and learning science.

The book is organized into four sections. Part I addresses historical and modern educational contexts. Part II focuses on teaching and learning scientific inquiry. Part III describes efforts in curriculum and assessment. Part IV contains chapters on teaching and learning about nature of science. The greatest strength of the book is in its efforts to combine discussions of research on learning and teaching inquiry and nature of science into one volume.

In the first chapter Rodger Bybee provides an important overview of scientific inquiry and nature of science related to curricular efforts. This chapter is an excellent introduction to what it means to teach science as inquiry. Bybee points to the importance of the learner to develop understandings, and that inquiry is not a single method of teaching. The second chapter by George DeBoer is equally important in reviewing the history of efforts in the United States to include inquiry in science teaching. DeBoer highlights prominent educational scholars during the last century, including Dewey and Schwab. He skillfully traces the history of inquiry teaching in the U.S. and the nuances of each initiative. DeBoer points out differences in rationales for using inquiry throughout the last century. Finally, he makes the important point that inquiry and hands on learning are not synonymous. In the third chapter Haberman artfully lays out an argument for the need to adequately prepare teachers of children of poverty, primarily in urban schools. Haberman points out the negative, yet realistic side of the situation, when he claims that some elementary teachers may unfortunately destroy a child's natural inquisitiveness.

Judith Lederman and Greg Stefanich address the importance of teachers in knowing how to teach ALL students, including those students having disabilities. The authors press for teachers to help their students develop higher-order thinking skills, even and especially, students with disabilities. In this chapter Lederman and Stefanich propose that inquiry and nature of science are important means of supporting children with disabilities

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and they offer instructional classroom strategies for engaging these students.

In Novak and Krajcik's interesting chapter, they describe a range of learning technologies that support children's inquiry about real-world questions. A strength of the chapter is the provision of actual classroom examples of children conducting inquiries; the chapter gives teachers a view of what is possible. The authors make the case that learning technologies can support children in acquiring deep and integrated understandings. A possible shortcoming is that the authors could have expanded the range of learning technologies, and extended their discussion of how to support underrepresented children in learning science. As is always the case in instructional technology, the field is constantly changing. Yet, Novak and Krajcik provide a firm foundation by emphasizing placing children at the center of their learning.

In Part II on teaching and learning scientific inquiry, Kathleen Metz proposes that the practice of science can serve as a heuristic for teaching science to elementary students. She is an advocate for younger children to go beyond making observations. In addition to the need to bring elementary school science into greater alliance with authentic science, Metz stresses that Big Ideas are important for elementary students, and that elementary school children are capable of carrying out many aspects of scientific inquiry.

Shirley Magnusson, Annemarie Palincsar, and Mark Templin argue the importance of community-centered views of scientific practice, and that scientific discovery is connected to the culture of the community. The authors link their views of nature of science and knowledge production to science instruction in the classroom, and advocate that classrooms need to be learning communities that reflect the culture of science. Simply put, they target the key role of conversations. This chapter serves as an important scholarly look at the intersection of inquiry, nature of science, community, culture, and classrooms.

In the next chapter Lawrence Flick reviews the literature on what children and teachers do in secondary science classrooms, as they engage in scientific inquiry. His emphasis on high levels of cognitive engagement is critical, and he stresses the interplay of students' and teachers' roles in this kind of complex instruction. Flick targets helping students to develop cognitive skills, as an important goal in designing inquiry-oriented classrooms in secondary school science.

Sandra Abell, Deborah Smith, and Mark Volkman thoughtfully pose important questions about inquiry in science teacher education. They ask, how should teacher educators support teachers in knowing how to successfully engage children in inquiry? These authors take a sociocultural perspective on learning. To illustrate their perspectives, they provide rich cases of personal endeavors in teacher education, including journal entries and student products. These example cases provide unique insights into the authors' philosophies and practices as teacher educators. Finally, they highlight the importance of developing a scholarship of teaching.

A false sense of inquiry teaching means that a teacher adopts a hands-off approach and leaves her students to discover science on their own. In his chapter on science inquiry teaching William Holliday addresses head-on the problem with using an unbalanced approach. He points out the confusion between inquiry and implicit and/or discovery teaching. Holliday strives to create a much-needed dialogue about science inquiry teaching, and how a teacher can strike a balance between explicit and implicit inquiry teaching.

The three chapters comprising Part III address curriculum and assessment related to inquiry in K-12 classrooms. In the first of these chapters Bruce Sherin, Daniel Edelson, and Mathew Brown raise the all-important issue of how to design innovative curriculum to support children science learning. The authors argue for designing task-structured versus content-structured curricula. The chapter is rich with examples from their curricular projects. The strength of this chapter lies in how empirical data can provide evidence for a particular curriculum's impact on children learning science content, and in providing guidelines for design of curricula.

In the next chapter Sandra Abell and James McDonald use their depth of knowledge to highlight a key problem—the limited view of inquiry in most elementary classrooms. In their chapter on envisioning an inquiry curriculum these authors argue for using an integrated approach. They support their vision with authentic classroom observations. Abell and McDonald recognize the limitations of using inquiry in elementary classrooms, yet they artfully suggest that science can serve as the leading edge to inquiry-oriented teaching in elementary schools.

In the final chapter in Part III, Edith Gummer and Audrey Champagne raise concerns about how states communicate expectations to teachers related to teaching science as inquiry. For example, states may over emphasize social issues rather than scientific ones. These authors provide specific examples using documents from New York, a state with a long history of standards and high stakes testing. Gummer and Champagne point to the inconsistency of images in instructional tasks with the nature of scientific inquiry in state standards.

In the first chapter of Part IV on teaching and learning about nature of science, Norman Lederman provides a grounding chapter on the syntax of nature of science within teaching inquiry in classrooms. Using a straight from the hip style of writing, Lederman is provocative in asking, can our students ever understand

the construct of atom or the theory of evolution, without having an appreciation and knowledge of nature of science? Lederman cautions that we will likely repeat our shortcomings of the last 100 years in science education, if we do not have adequate professional development for teachers and provide our students the themes of nature of science and scientific inquiry.

Richard Duschl is well known for his research on the role of explanation and theory in science education and development of students' epistemic reasoning. He begins his chapter on history of science and its relationship to learning and teaching science with Thomas Kuhn's thesis about scientific knowledge and periods of revolutionary science. Duschl poses the important question, what history and whose history should define curricular models, instruction and assessment of science? Using three personal stories he illustrates the challenges in using history of science as a framework for designing curriculum.

In their chapter Renee' Schwartz and Barbara Crawford explore the effectiveness of authentic scientific experiences as a context for teaching the nature of science. Based on an in-depth contemporary review of the literature, they argue that authentic scientific experiences can provide a context for reflection on nature of science. Yet, these experiences alone are not sufficient to change students' and teachers' views of nature of science. Schwartz and Crawford suggest critical elements for successfully teaching nature of science using authentic scientific research experiences.

In perhaps one of the few chapters on teaching of nature of science and inquiry in higher education, Harry Shipman begins with a narrative, depicting a conversation he had with one of his colleagues about inquiry-based teaching in college. Shipman offers feasible suggestions for how to teach nature of science through inquiry in higher education. The chapter is useful to both scholars and college level instructors, who are considering a shift from traditional, teacher-centered instruction to student-centered, inquiry-based instruction. I have successfully used this chapter in a graduate level course for science Ph.D. students who take time from their laboratory research to participate in a seminar on Innovative Teaching in the Sciences.

The next chapter on college students' views of nature of science is a logical one to follow Shipman's chapter. Fouad Abd-El-Khalick reports that college students have naive views of nature of science, similar to those held by high school students. He raises the concern that unlike other studies in which labels were used for learner's views, the participants in his study had fragmented views of NOS. Using the literature Abd-El-Khalick calls into question current instruments used to assess college students' views of nature of science. Further, he highlights the importance in science education of enhancing preservice teachers' understandings of NOS.

The final chapter by Randy Bell tackles the important issue of appropriateness of teaching nature of science to students across the range of grade levels. Bell cites the bulk of research that points to children's inadequate understandings of nature of science, if the instruction focuses only on the products of science, and does not explicitly attend to the values and assumptions of science. Bell raises important questions about what aspects of nature of science are appropriate to teach elementary students, and leaves the reader with a challenge to continue research on how to move ALL students towards scientific literacy.

This book certainly is not an end to the discussion of how inquiry and nature of science contribute to scientific literacy for all ages of students. Instead, this book serves as an important and provocative starting point, and its use will surely generate much needed dialogue about teaching practice and future research on learning about scientific inquiry and nature of science. Science education researchers, as well as teachers at all levels (K-12 and college level), will find this book extremely valuable. This book can serve to build a firm foundation for teachers' understandings of issues related to teaching about inquiry and nature of science. Further, science education researchers will find the book an importance reference for developing and extending their own research agendas, as they work towards findings answers to important questions raised in this book.

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Dr. Crawford is a science education researcher with a almost twenty years of science teaching experience. The ultimate goal of Dr. Crawford`s research is to facilitate the majority of students in science classrooms in developing images of science consistent with current practice, and in understanding what science is, what science is not, and the relevancy of science to society.