Questions, Claims, and Evidence

The Important Place of Argument in Children's Science Writing

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This book is dedicated to the teachers and students
who were willing to give the SWH approach *a go*.

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Acknowledgments

It seems only appropriate when writing a book about science writing that we should use the very template that we advocate for science inquiries to express our gratitude to the many people who made this book possible. It all started with a question.

1. *Beginning ideas:* We had a question: "How does the Science Writing Heuristic approach work in the elementary classroom?" To answer this question, we had the help of many school districts, teachers, students, and administrators who joined us in this inquiry, asked their own questions about science and literacy, and pushed us every day to think deeply about teaching and learning.

2. *Tests:* The test was to examine the use of the SWH approach with classroom teachers in preschool through sixth grade. This work would not have been possible without the support of a Math-Science Partnership grant and the State of Iowa who supported the teachers and researchers to engage in this investigation.

3. *Observations:* We observed, interviewed, videotaped, analyzed, and took notes. We had dialogue and examined our data, which lead to new observations with an amazing research team including Murat Gunel, Recai Akkus, Sara Nelson, Sarah Trosper, Kyle Rasmussen, Elham Mohammad, Ryan Kelly, Ahmad Al-Kofahi, Bill Crandall, and Jay Staker. Over the years we have had numerous undergraduate students who have provided support to this project—managing data, scoring writing samples, transcribing, and analyzing: Micale Coon, Jessica Drey, Alicia Johnson, Kevin Jolly, Katie Raymon, Lisa Ryherd, Katherine Schnoor, Sara Ann Smith, and Ashley Titman. In addition, many preservice teachers participated in this project by providing an audience for SWH classrooms by reading and responding to penpal letters. Your thoughtful response over the years has made writing purposeful for children. Finally, a special thank-you to the many freshman honors mentees who chose to participate in the project as beginning researchers; your insight has been invaluable.

4. *Claims:* We made claims based on the evidence. Having the opportunity to "go public" with your claims and thinking is a key part of the learning process. Daily, we share our thinking with our colleagues, students, teachers, and friends at Loess Hills Area Education Agency 13, Iowa State University, and the

University of Iowa. We thank you for your continued support of our questions as teachers, researchers, and writers.

5. *Evidence:* Once the evidence was gathered, we reflected upon our understanding by writing. The results were overwhelming—when teachers are willing to re-examine their beliefs about teaching and learning and give the process a go, students and teachers are successful. Here we must thank the support of sixty teachers across the United States who read the first draft of this book, "had a go" in their own classrooms, and gave us extensive feedback to bring this revised draft to you. The field testing of the first draft was supported through a Teacher Professional Continuum grant (No. ESI—0537035) through the National Science Foundation. An advisory board has also provided thoughtful response and feedback on our efforts including Donna Alvermann, Sharon Dowd-Jasa, Todd Goodson, Kathy McKee, Wendy Saul, and Larry Yore. We thank you for your wisdom and continued "nudging" as we grow in our own understanding of teaching and learning, science and literacy.

6. *Reading:* We asked the experts—of course, the teachers and the students whose stories you will read in this book—but a special thank-you to Jan Westrum and Allyson Forney who read very early drafts of this book and provided insightful feedback about audience and style.

7. *Reflection:* Finally, reflection—in reflecting on what has made this project possible, we must thank our program assistants, Tracie Miller and Allison Donaldson. Your attention to detail, pep talks, humor, and ability to multitask has made this book an intriguing endeavor as you both reminded us daily of the important work we were doing. Also, a special thank-you to the Heinemann Team and Robin Najar for seeing the value in this project and providing ongoing questions to fuel the writing (and future investigations!).

And, with extreme gratitude and pride, we thank our families who create spaces and time for us to practice what we teach and continually encourage us to have a go with our many questions, ideas, and projects about teaching and learning.

CHAPTER 1

Questions, Claims, and Evidence

Examining Our Approach to Science Teaching and Learning

Voices of the Students in a Fifth-grade Classroom

> I love the way that we do science now rather than how we did science in fourth grade because I learn more and I get to do more. I actually feel like I am smart.
>
> I love doing science because we get to conduct our own experiments. I learn a lot more because if I do the experiment I know that it's true. Because how do I know if what they're saying is true? I like this better than using a textbook because I have to use my brain to think about the experiment and if you read a textbook—it just gives you the answers without thinking.
>
> I don't like using textbooks at all. I like using the words *CLAIMS* and *EVIDENCE*. I'm enjoying the fact that I am using experiments all the time. I think you can learn a lot without using the textbook all the time and because I don't think your textbook tells you all the things you need to know.

Voice of the Teacher in This Fifth-grade Classroom

When I was approached to teach fifth grade it was with the condition that I would be responsible for teaching two sections of science. My heart raced. Science????? That "S" word??? I hated science all through my own schooling and had set up exploration centers for the science concepts when I taught kindergarten. Now I actually need to be knowledgeable about the different aspects of science. Could I do it? The jury is still out, but the process has generated enthusiasm and excitement for my students and myself.

From the voices shown in the previous section, it is difficult not to be intrigued by this approach to teaching and learning that has students and the teacher in this fifth-grade classroom abuzz. This teacher has been in the process of implementing this innovative science and literacy approach that incorporates asking questions, making claims, and gathering evidence into her teaching repertoire. For many elementary teachers, in the wake of the No Child Left Behind Act, we have seen science pushed out of our curriculum in favor of a focus on reading and mathematics. In this classroom and many others across the country, teachers are examining ways to link language and literacy experiences with rich science inquiry, and as evidenced in the previous

statements, it is having a powerful impact on the learning of students in elementary classrooms and beyond.

About the Approach Used in This Book: The Important Place of Science Argument

So, what is this process that is supposed to help students learn science better, to encourage them to pose questions and explore their answers, and to do better on a variety of assessment measures? Why is there a need to move away from the traditional approaches to science teaching? We know that the number of students moving into science and science-based careers is decreasing—why? There are a large number of factors, but as teachers of science we have to ask ourselves what we are doing in our classrooms that fail to promote, encourage, and stimulate students to take up careers in science.

Traditionally, science laboratory activities are structured around the laboratory report format. Students are expected to engage in a format that outlines the hypothesis, procedures, observations, results, and discussion. Unfortunately, this format is typically used by scientists only to report their work to journals for publication. This is not what occurs in science laboratories. Scientists are involved in posing questions, making claims, providing evidence, debating with each other, comparing their answers with others in the field, and attempting to look for patterns across their results. Scientific argument is at the very core of science activity. Having completed this process of argumentation, scientists then prepare their written reports for publication.

While there has been much work done on examining the strategies required by teachers to be successful when using inquiry, two areas of concern still exist. The first is the lack of emphasis on argumentation, and the second is the limited or almost nonexistent focus on language use and its relation to science learning. In elementary classrooms, there is an additional concern that science has been pushed out of the curriculum to provide more time to focus on reading and mathematics. To address these concerns, we would like to share with you a new idea or, rather, an approach to thinking about science that offers a variety of language and literacy learning opportunities paired with quality science inquiry. We call this an approach because it is not a kit or a slick little strategy or a new scripted program. Instead, it is a *lens*—a lens to examine what we do and how we structure learning opportunities in our classrooms. Throughout the coming pages, we plan to share with you this new lens for you to try out and to expand your understanding of teaching and learning, science, and literacy.

About This Book

This book is designed to give you the opportunity to explore the approach in your own classroom. With this in mind, the book is divided into three sections. The first section is aimed at providing some *background* examining teaching, learning, and writing. The authors believe it is essential to recognize that using this approach requires more than

simply gaining a new strategy. We need to review our understanding of what learning is. Is it transferring information? Is it about constructing knowledge? Most important, we need to examine how our view of learning matches up with our view of teaching. This section examines our perspectives on learning and teaching and how these perspectives are critical for using the approach. The section finishes with a discussion on language, focusing on writing and its essential function in learning science.

The second section deals with the *implementation* of the approach. We have structured this section around the student plan for the approach. We begin in Chapter 5 with an exploration of the art of questioning and how to help students to ask good questions. In Chapter 6 we describe how good questions lead to the gathering of evidence. Chapter 7 deals with making claims and how to assist our students in analyzing and reflecting on their investigations and research. Chapter 8 takes the reader to the conclusion of the process where students reflect on their learning through the summary writing experience as well as a discussion about assessment. The intention of this section is to introduce the teaching considerations required when using the approach focusing on student learning in elementary classrooms (K–6).

The third section is framed around how to examine *teaching practices* and a review of *frequently asked questions*. Chapter 9 begins by providing an overview for planning your first unit and introduces a performance matrix that we have used throughout our studies when working with teachers. The intent is to provide guidance to teachers so that they can examine how well they believe they are implementing the approach. Chapter 10 deals with frequently asked questions posed by teachers and an overview of the research findings related to this approach over the past nine years.

Particular features of this book include many opportunities to read the stories of teachers and students in elementary classrooms as well as pose some challenges to engage the reader through the pages of this book. Each of these special features is set off in the text. These features include:

TEACHER'S VOICE: We believe the teacher's voice is essential to our work, and we have included their stories of joys and struggles, aha moments, and frustration points to help describe in detail the implementation of the approach.

FROM THE STUDENTS: Throughout the pages of this book, we will provide examples of student writing and the student voice from inside classrooms, prekindergarten–sixth grade, to help you get an insider perspective on student learning.

CHECK THE EXPERTS: Just as there is a place in the plan for the students to read about what others say, we have provided many links to other research, helpful websites, and resources for further reading and investigation.

BOOKS AND TOOLS: Over the past nine years, teachers and consultants who have worked with this approach have developed a variety of tools. Many of these tools are provided throughout the book to help you get started in implementing your own unit. We also will share a variety of books and ideas that fuel our own science-literacy investigations.

HAVE A GO: Finally, the book concludes with the "have a go" appendices. These featured activities are for the reader to try in and out of the classroom setting to engage in active learning experience around the implementation and examination of the approach.

We have written the book with guidance from a group of teachers who have been using the approach over the past three years. They have provided insight and critical

comments and made sure that we as authors are focusing on the children and the realities of the classroom. We thank this group.

Who are we, the authoring team of this book? We are teachers, too—teachers who continually examine our own teaching in science and literacy with children and adults. Thus, in the pages of this book we will use a collective "we" as we stand with you asking questions about how children learn, how we orchestrate learning opportunities, and how we continue to ask questions, make claims, and gather evidence—the same actions we are nurturing in our students.

We hope you enjoy the book and take up the challenges that are presented in the following pages. Taking the time to work through some of the suggestions and advice has been very beneficial for all the teachers and students who have been using the approach. In the wise words of another fifth-grade student, "I think using this system is more fun and easy. Learning with experiments is a way to understand. I don't know why anyone wouldn't want to do it. What are you waiting for?"

How Do I Know What My Students Know About the Big Idea(s)?

Research is clear that for students to learn, they must first be aware of their current understanding. There are many ways to activate prior knowledge while determining what kids know in order to inform instruction. You can read more about these strategies in Chapters 5 and 8.

Concept Maps

The steps we use in developing a concept map follow:

- Write the topic to be studied—the big idea—on a large piece of paper, the whiteboard, or the chalkboard. The map should be in a large enough area that students will be able to see it, preferably in an area where the map can be left to add to as new understandings and negotiations are made.
  - The topic can be placed in the middle, on the top, on the side, or on the bottom of the map.
- Give students sticky notes. Instruct students to think about what they know about the topic by brainstorming.
  - On each sticky note students write one word or phrase about the topic.
  - Students write their initials or names on each sticky note they write.
- After students have time to brainstorm, students bring their sticky notes up to the board and read them to the class.
  - Sticky notes containing the same phrase or key word are placed on top of one another.
- The teacher and the students work together to group or classify similar ideas into categories.
- Linking words are added to the map to connect the concept to the categories so that anyone who looks at the map can see how each item is related.
- As the students negotiate new understandings, additional sticky notes are added. These sticky notes are generally a different color than the first notes placed on the map.

Primary teachers might find the following modifications useful in developing the concept map:

- As students brainstorm, the teacher can record each thought and/or draw a picture on $8\frac{1}{2} \times 11$ paper instead of using a sticky note.
- After the brainstorming session, the teacher and the class work together to group the ideas into categories. This categorization can be done on the board or on the floor. One possible way to help students visualize this process is to use yarn and place it around the categories once they are established.
- Yarn can also be used to link the concept to the categories of words. Tape or staple the linking word on top of the yarn. Linking words, which help everyone see how the categories relate to the topic, can be as simple as *are*, *makes*, or *have*.

Posting the concept map in a prominent place in the classroom helps to keep the class focused on the learning and the big ideas. Students enjoy adding to the concept map and changing it as they develop and negotiate new understandings. See some examples of student concept maps in Chapter 3. Various other graphic