Voices from the Classroom

Elementary Teachers’ Experience with Argument–Based Inquiry

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There is much attention currently being given to argument-based inquiry in national and state curriculum documents. Students are being required to be able to generate and evaluate science knowledge, and to think critically and judge the value of evidence and explanations. The intent of the book is to provide a rich and broad view of the impact of argument-based inquiry in the elementary classrooms from the perspective of the teacher. All the teachers and professional development authors were engaged in promoting and using argument-based inquiry as the approach to teaching science. They were implementing the Science Writing Heuristic (SWH) approach as the argument-based approach for classroom practice.

As researchers we constantly work to present our views of these experiences with the voice of the teachers only being relayed through the perspective of the researcher. The intent of this book is to provide an opportunity for us as a community to listen to what the teachers are telling us. Importantly as demands are being placed on classroom experiences that provide opportunities for students to pose questions, make claims, and provide evidence, that is, to think critically and reason like scientists, we need to understand what this looks like from the perspective of the teacher. This book brings together a range of elementary teachers from kindergarten through to year 6 who have used the Science Writing Heuristic approach to teach argument-based inquiry. These teachers have all gone through professional development programs and successfully implemented the approach at a high level.
Voices from the Classroom
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DEDICATION

To all the teachers who are willing to “have a go” with the SWH Approach and to truly examine daily what it means to teach in the service of learning.
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QUESTIONS

We began with the question, “How can we support teachers to engage students in science and literacy with the SWH approach remembering that we must teach in the service of learning?” 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. 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.

CLAIMS

Our claim is that this book would not be possible without the support of our colleagues at The University of Iowa, Iowa State University, and The University of Louisville. Specifically we must thank, Tracie Miller, Denise Dadisman, Mitch Williams and Allison Donaldson. Your attention to detail, pep talks, humour, and ability to multi-task made this book an intriguing endeavour. You reminded us daily of the important work we were doing. Daily, this work is made richer through our work with both graduate and undergraduate students who join us in this research endeavour. Also, a special thank you to Sense Publishers and Michel Lokhorst for seeing the value in this project.

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 authors of the chapters of this book who “had a go” with the SWH approach in their own classrooms and took the time to write about their own learning and thinking at this time. The creation of this volume was supported by a Teacher Professional Continuum grant (No. ESI – 0537035) through the National Science Foundation. A consulting group provided extensive feedback on our efforts and pushed our thinking. That group included Lynn Hogue, Mickey Sarquis, John Tillotson, Leah McDowell, Bill Crandall, Kim Wise, and Jodi Bintz. Additionally, 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.

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.

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BRIAN HAND AND LORI NORTON-MEIER

INTRODUCTION

Teaching in the Service of Learning

Okay. I am officially hooked. Three of my classes got into arguments about whether or not matter can be created/destroyed or if it just changes. They talked about how energy has to be involved, whether or not a baby is created, what happens to dead animals when they decay, it was awesome! There were excellent points on both sides. I had to put my hand over my mouth to keep from joining them.

I am seeing roughly the same amount of fact retention at this time with SWH as I did when I was teaching with a more traditional lecture/notes method but my kids then would have never been able to argue with evidence as my kids did today. All of this and I have only begun to learn how to teach using SWH, I can’t wait until I am halfway skilled in the approach! Thank you for helping us with this, both of you. (Email communication from James Haver, October 15, 2010)

James Haver is a sixth grade teacher who is new to the SWH approach and is in his first year of implementation. In this volume, you will hear the voices of teachers just like James who will share their own professional narratives … narratives that detail their professional journey to implement argument-based inquiry into their own classrooms. Their stories of not only teacher learning but also student learning are compelling. So, just what is this approach that has a group of teachers talking, as James does in his email communication above, about the transformation they see happening in their various classrooms?

There is currently much interest within the science education community on the use of argument-based inquiry approaches within school classrooms. The intent of these approaches are to provide students experiences that are more closely aligned to how science is done, rather than on the traditional inquiry approaches that have been used over the last 10–15 years. There are a number of different perspectives about these approaches ranging from teaching students how to argue before they “do” science argument to teaching science argument as a critical component of an inquiry approach. The editors are firmly in the camp of the latter perspective in that we believe students learn about argument by “living” the argument as part of their inquiries.

This book is intended to provide the opportunity for teachers, who are interested in implementing argument-based inquiry into their classrooms, a chance to look inside the classrooms of teachers who are using the approach. The book brings together
teachers from Kindergarten through to grade 6 who have taken a chance on rethinking about how they teach and have shifted their focus to be about learning rather on themselves as teachers, as well as some of the professional developers who are working with these teachers. All the teacher authors believe that their students need to focus on framing questions, making claims and supporting their claims with evidence. They are firmly committed to the idea that students need to live the language of science by using the language science as they experience it.

ARGUMENT-BASED INQUIRY AND WHAT IS NEEDED

In building a picture of argument-based inquiry, we need to discuss what are the critical elements of argument and how this varies from some of the early inquiry approaches. While there has been much discussion within the science education research community about what are the critical elements of science argument, the translation into practical teaching approaches has not always been clear. Importantly there are a number of different perspectives that researchers have taken in working with teachers. Some approaches highlight the need for students to be involved in critical discourse about science. That is, students need to learn about the importance of how scientists build knowledge. Students need to be able to engage in the argumentation approaches that scientists used to advance knowledge. To teach students about this, these approaches advocate a need for students to be taught about argument before they get to use the process. Students need to understand what the argument is, prior to them being engaged in doing science.

While we do not disagree with the idea of students needing to engage with argumentation, we believe that it is necessary for them to be actively involved in building their arguments as a process of learning about argument. We can teach students to engage in inquiry activities based on a questions, claims and evidence structure, that is, an argument-based inquiry approach. Students are full of questions about topics – we just need to let them express them and negotiate which of them are worth exploring. By placing demands on them to negotiate between the data they collect, and what claim they can make from the data, we can push them to deal with the concept of evidence. Children can be pushed to write a narrative that explains what data points they want to use and why they want to use them. We can help them understand that data plus reasoning results in evidence. Evidence is not free of reasoning. This is critical for us because we have to stop students from reporting under evidence or results – “see data” as though data speaks.

The approach used by the teachers in this project is the Science Writing Heuristic (SWH) approach. This approach was developed in the late 1990’s by Brian Hand and Carolyn Keys and is intended to encourage students’ negotiation of science through an argument-based structure. The following template (heuristic – a problem solving device) is the one a student is required to use for any inquiry activity (See Figure I.1).

As part of using such a structure, students are required to both publicly and privately negotiate what are their claims and evidence. They are constantly required to reason through their data, other students’ data and the public debates that are the norm of the classroom environment.
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1. Beginning ideas - What are my questions?
2. Tests - What did I do?
3. Observations - What did I see?
4. Claims - What can I claim?
5. Evidence - How do I know? Why am I making these claims?
6. Reading - How do my ideas compare with other ideas?
7. Reflection - How have my ideas changed?

Figure I.1. The SWH approach student template.

The use of such a structure is based around involving students all along the way – they help pose questions, take part in public debate of their claims and evidence, and search the literature to see how their ideas compare with others including the practicing scientists. Science becomes something that they construct and critique, where their ideas are valued and debated, and where words such as “prove” are no longer the norm but replaced by “scientifically acceptable”. Science knowledge is to be contested and understood for that knowledge as being the best fit at the current moment.

DO TEACHERS NEED TO CHANGE?

If we want to have children actively involved in a question, claims and evidence approach to inquiry, we are going to have to make changes both in how we think about learning and how we act within the classroom. Rather than trying to talk about it from an academic point of view, we have inserted the words of Josh, one of the teacher authors of this book. He was asked by his school’s curriculum coordinator to explain what the SWH approach is all about. He chose to reply in the form of the SWH template.

Claim:
The Science Writing Heuristic focuses on student learning.

Evidence:
Traditionally, teachers are the center of the classroom and all information comes from them. This model of teaching has little impact on the students, in particular critical thinking. The students learn how to play the “guess what’s in my head” game, and therefore, can answer the teacher’s questions the way he/she wants. This simple recall of information does not cause the students to think critically about what is going on in the classroom.
The following question is essential to understand: What is teaching, and what is learning? When looking at the first part, teaching, one must understand that a teacher can NOT put information into a student’s head. The teacher has absolutely zero control of learning. For example, as you are reading this claim and evidence, I cannot “teach” you about teaching and learning. For if I could, you would then agree with me and the conversation would be finished. Rather, you are negotiating what you believe to be true based on your previous negotiations (readings, experiences). So what is teaching? Teaching is the management of the classroom. This is a crucial part of the student’s day. As the teacher’s management keeps the environment safe and productive, it provides opportunities for the students to negotiate their current understandings.

Learning, the second part of the question is also known as negotiating your previous framework to make new meaning. The complexity of learning comes in when we begin to look at how the teacher’s role is so powerful. Even though a teacher has zero control over the learning, they still have 100% control over the environment. Students who are not given public opportunities to negotiate only have private negotiation. Ideas that never go public can’t be understood by the teacher (for planning) and cannot be challenged by other students/peers/teacher. If learning is negotiation, what is the level of learning in classrooms without public negotiations?

The focus of SWH is negotiation. In this approach, teachers use the students’ interest to gain questions. These questions surrounding the “big idea” then give direction for the class. As the students begin to investigate their questions they begin to find additional support, changes needed, or new ideas about why things are and how they work. All of this is done on various levels: self, peer, expert. Each is equally beneficial.

One might say that SWH is limited to the science classroom. If you step back to look at science, science is language around science. Science is a world of theories that we are continually adjusting by the use of language. If you pulled the language (reading, writing, speaking, listening, symbol/picture, body language) out of the science classroom, you wouldn’t be productive. The same would be true for all other subject matter. SWH, rather, is an argument-based approach that makes the curricula both rigorous and relevant. This is not a strategy.

If one truly believes that learning is negotiation, then what does the planning look like? The teacher still decides the “big idea” based on the Iowa Core Curriculum (ICC) and the district’s requirements. From that point, the teacher has to look at a concept map of what they know, what is the structure of knowledge for understanding the “big idea”, and additional research that may need to be done to understand the topic. Once the structure of the “big idea” is understood by the teacher, then they can start looking for the activities/experiences that could be offered to the classroom when the questions arise. It is critical to start with where the students are with their understanding of the “big idea”. A quick pre-activity will allow the teacher
INTRODUCTION

to know what they do or do not know. This also leads the students into questions. These questions are what would drive the rest of the unit. Activities/experiences are NOT sequential. Rather they should be utilized to best help with parts of the concept map, student questions, and tie back to the ICC.

Traditionally a teacher has set lesson plans from day 1 to day X based on the ICC or district requirements. This past year we looked at rigor and relevance, which I called a strategy for planning. Teachers tried to say why things are relevant. Who are we to say why things are relevant? Is it our learning or the students? Very similarly we tried to develop a unit plan or lesson plan that was rigorous. If we are about the student’s learning, why are we planning how an activity will go, what will be done a head of time, and never negotiate?

There are many things being addressed by Josh – the need for negotiation, the setting of, and focus on, the “big ideas” rather than content facts, planning that builds off where the children are, and the idea of a possible non sequential order to the unit. While this list is not exhaustive, it does highlight that there are some significant changes that teachers need to engage with. All of us using this argument-based approach believe that our job is not about teaching but rather about learning. We in science education, and in education in general, have real trouble translating the learning theories that underpin the philosophy of science teaching into classroom practice.

Our focus in working with the teachers is not on a particular curriculum product, or a curriculum that we have developed (we have not done this or are interested in this task), but rather on challenging them to translate learning theory into practice. Every teacher adopts a curriculum to suit him/herself. If we focus on learning theory, and build teaching practices that address the theory, then teachers can use these regardless of what curriculum they asked to use. The SWH approach to argument requires teachers to understand and adopt a learning is negotiation approach to their classroom. While this is difficult, the rewards are significant.

THIS BOOK

Each of the authors or teams of authors have used the SWH approach within their classrooms or in helping teachers to use this approach. The authors have had success with this argument-based inquiry approach. However, the journey has not been easy for them. All the authors have had at least three years experience using the approach. They have all stumbled, been supported through their struggles and are still using the approach.

The chapters are intended to provide you with a snapshot of various aspects of what goes on in their classrooms, or with the professional providers who work with the teachers. The book is intended to help the reader to see that it is not all a bed of roses – it is not going to happen overnight, nor will it be without trouble spots. However, we believe that persistence will be reward.
The authors span teachers of young children through to 5th and 6th grade teachers. The early grade teachers do involve their students in public negotiation – students can make claims and provide evidence for their claims. The older children do develop more sophisticated arguments, but they are still based around a question, claims, and evidence structure. We encourage the reader to read this book in conjunction with our Question, Claims and Evidence (QCE) book (Norton-Meier, Hand, Hockenberry & Wise, 2008), as this will help provide the teacher stories behind the how to do the SWH approach which is the focus of the QCE book.

In particular, the reader will see three themes that emerge in this book. The first four chapters focus on the central theme of the SWH approach: There is no science without language. Lynn Hockenberry begins with a discussion of how language is used to learn in SWH classrooms followed by a chapter by Michelle Harris where she illuminates the role of discussion in the negotiation of learning. In Chapter 3, Michelle Griffen talks about the breadth of language demonstrating how reading, writing, listening and thinking are essential to the work of children as scientists. Finally, Amy Higginbotham and Christine Sutherland discuss the role of writing to their young students negotiation of meaning both in science and their developing understanding of how language works.

The second theme that appears throughout the volume but is particularly the focus of the next four chapters is that negotiation is central to learning. Kim Wise describes the focus on learning in Chapter 5 and how teachers engaging the SWH approach create classrooms where children learn. Following up on Kim’s chapter, Joshua Steenhoeck, Jill Parsons, and Kari Pingel discuss in Chapter 6 how the SWH lens has created a powerful space where their sixth grade students can negotiate their understandings about challenging science content. In particular, the authors focus on their use of technology to open up the opportunities for ongoing negotiation both in and out of the school setting. Often, members of the professional community doubt if young children can engage in this form of argument-based inquiry. In Chapter 7, Julie Sander details the learning of her kindergarten students who did in fact learn to use argument through science conversations. Peggy Hansen continues the conversation by highlighting the use of the terms claims and evidence in a fifth grade classroom and how this transformed not only her thinking but also that of her students by turning science learning into a space for negotiation.

The final theme is that only the learner controls learning so we must organize our classrooms so that all students can engage with the big ideas of science. In Chapter 9, Carrie Johnson talks about her experiences watching the classroom environment transform as teachers engage in argument-based inquiry. To lend a more detailed picture to the discussion of environment, Cheryl Ryan and Gina Johnson describe their third grade classrooms and in particular focus on how the use of nonfiction literature helped transform students thinking and help students learn science conceptually, not just random content facts. Building on their chapter, Julie Malin describes in Chapter 11 how her first grade students use concept maps to build their understanding of science topics while simultaneously experiencing how language helps us think about what we know and how we know it. Finally in Chapter 12, Sara Nelson describes her unique project where she uses music as a tool for students to summarize their
learning with putting together science content learned with lyric writing. The result is an important learning experience where students are asked to transfer what they know into a new context.

We ask you to enjoy this journey that will take you through the pages of this text. As researchers, teachers, professional development providers, administrators, parents, and other interested community members, we believe this book has many lessons to be learned about teacher learning, teacher transformation, and how we support teachers to continually be able to challenge what they know and how we can continue to orchestrate opportunities for all students to learn in our classrooms. We started this introduction with an email message from James who has just started this journey with the SWH approach … it is our hope that this volume will let him know as well as those of you reading this text also, that many have taken this journey and continue to ask important questions about teaching and learning. Let our journey continue.

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1. USING LANGUAGE TO LEARN

As a literacy consultant, I have the opportunity to travel to and work with many schools, teachers, and students in K-12 settings. One of the most important aspects of my work is that of supporting the Science Writing Heuristic (SWH) approach to teaching and learning. On a dreary early winter day, my travels took me to one of my favorite schools in a small town in Southwest Iowa. My intention that morning was to quickly touch base with the fifth grade teacher and establish a time for a future observation. The teacher met me at the door with a smile and said, “Do you have a minute? I would love for you to see the writing my students are doing!” At that point, I sensed the dreary day would soon be forgotten and this would definitely not be a “quick stop.”

I listened as the teacher began describing a recent day in Science. Students were at the point in their SWH investigation where they were reading to explore “what do others say”. She told me that she decided to try something new and have students investigate the ways in which authors of non-fiction structure and organize text. Students generated charts (See Figure 1-1) noting what authors of non-fiction did to help their readers understand the science content. The teacher spoke excitedly as she described the enthusiasm students had for this task. After exploring non-fiction text and creating charts, her students asked if they could write their journal entries in a similar manner. Because she understands the power of students using language to learn her response was an immediate, “Of course”. She was excited and amazed at the ways in which students were now demonstrating their understanding in their science journals.

As she finished explaining this process to me, she asked students if they wanted to share their writing with me. The response of the students was an overwhelming, “Yes”. All of the students reached into their desks, pulled out their journals and turned to their most recent entries. They all wanted to show me their “non-fiction” writing. Smiling, I walked from one group of students to the other, reading each and every non-fiction entry. Each student provided me a detailed explanation of the reasons they chose to write their entry in this manner.

Here are sample conversations from three different students that morning. A confident young man told me, “I had different words that were bolded and wrote what they meant, “transparent”, “translucent” and “opaque” and then (I drew) a picture to go with them. I wrote what happens to a white light when it goes through a prism and drew this picture” (See Figure 1-2).

When his teacher asked him to tell me what he liked about writing in this way, he said, “I personally think it is a much better way to record my thinking because I can understand it in a better way. I remember it better because of the picture.”
Figure 1-1. Students generated charts noting what authors of non-fiction did to help their readers understand the science content.

Figure 1-2. A student writing sample where he uses text features to demonstrate his understanding.
Another young man in the group said, “Sometimes when I read text and see a word I don’t know, usually if it has a picture; I can understand it better, so I wrote this way.” He turned his journal toward me so I could read and see the picture he had drawn to explain the word “opaque”.

I walked toward another group of students sitting at a cluster containing three desks. Shyly, a young lady handed me her journal. She said “I wrote words over here and then drew pictures of what it (each word) is for and then I wrote, “The sound is traveling through the wall”.

As you might imagine from my description, my “quick stop” became an hour conversation with students. What a day brightener! I was so happy to have the opportunity to read, listen, talk, view and share the excitement of learning with these young scientists and authors. As is often the case after observing and conversing with students and teachers in SWH classrooms, I was excited and delighted to see and hear the learning that was occurring inside these four walls. Students were engaging in science content and they were using language to negotiate their own understanding and communicate that understanding to themselves and others.

Before I became a literacy consultant, I implemented the SWH approach in my classroom for several years. The very thing I loved as a classroom teacher, watching children discover the joy and excitement of learning, was clearly evident in this classroom. This morning’s visit was a reminder and a testament to the power of using language to learn and the SWH approach.

THERE IS NO SCIENCE WITHOUT LANGUAGE

The SWH approach holds as a central belief “There is no Science without language” (Norton-Meier, Hand, Hockenberry, Wise, 2008). Language (writing, reading, speaking, listening, and viewing) is fundamental to this approach. A cornerstone then to the approach is that we “use language to learn” (Norton, Meier, Hand, Hockenberry, Wise, 2008). In the classroom described above, students had investigated the ways in which authors of non-fiction science text structured and communicated their ideas. Their investigation led them to discover that most non-fiction texts have certain text features; bold print, colored font, headings, captions, labels, pictures-photographs or drawings, boxes containing key ideas or information, glossaries, etc. Students were then given the opportunity to write in their journals in “a non-fiction way”. As their journal writing and verbal reflection indicates these students are using language by reading, writing, viewing, and speaking as apprentices in the disciplines of both science and language. In this case, I refer to the definition of an apprentice as “a learner” or “one who is learning a trade or occupation” (Dictionary.com, 2010).

If we think about these students as apprentices, then why is it beneficial to apprentice students in the use of both language and science? According to Carolyn Shanahan (2004, p. 75), a lab scientist was asked “how much time he spent in reading and writing activities associated with his job. He said that he read and wrote approximately 99% of the time he was at work.” In addition, Shanahan states “Reading and writing about science is also required of anyone who wishes to be an informed consumer or an engaged citizen”. In this same chapter, Shanahan (2004, p. 89) discusses
results of a study by Tucknott and Yore (1999) in which they found that “4th graders improved their understanding of simple machines when they learned how to take notes, make summaries, and write sentence and paragraph explanations for drawings and labels.” Studying the writing of non-fiction authors leads to authentic representation of the work of scientists who use “labels, graphs, equations, tables, diagrams, and models” (Hand, 2008) as well as written text to communicate their ideas. The students in this 5th grade classroom are well on their way to becoming “real” scientists.

EXAMPLES OF WAYS IN WHICH STUDENTS USE LANGUAGE (WRITING) TO LEARN THROUGHOUT THE SWH APPROACH

Writing in a “non-fiction way” is just one way that students in SWH classrooms use language to learn. The students in the 5th grade classroom I have been describing agreed to share with us some other ways in which they use writing to learn about science concepts. As is customary at the beginning of an SWH unit the teacher, in order to identify students’ current understanding and plan for instruction, had students create a concept map. Using a concept map helps teachers identify students’ current understanding and make plans for instruction. A concept map centers around what student know and understand about the big idea of a science unit. The big idea is a kid friendly conceptual statement, which aligns to the science essential concept. Development of a concept map helps students orient themselves to the big idea while drawing upon their past experiences and connecting with what they currently understand related to the science concept.

As Hillocks (1987, p. 72) states “Children need to learn to conduct a memory search to help them tap into the knowledge that they have about a concept. Students appear to need to do a memory search to gather their thoughts.” Concept maps allow students not only to conduct a “memory search” but also to link their understanding in ways that our brain naturally organizes information. Importantly, it provides a visual representation of their thinking, which is key for both students and the teacher. Here is how one-fifth grade student explained the development and importance of a concept map:

A concept map is like where we write down the main deal, which is energy, and what we are learning about energy, which is light, sound and heat. We have different color writing utensils. The pencil is what we learned first, the red pen is what we learned second, and the black pen is what we learned over the whole unit. It is different than a word web because it uses connecting words. We write down what we learned to help us remember.

Thus the concept map becomes not only a tool to help to help both the teacher and the student identify current understanding, but a tool to help students reflect upon and consolidate their learning. When students use language (in this case writing) to learn, it serves as a “catalyst for further learning-an opportunity for students to recall, clarify, and question what they know and what they still wonder about” (Fisher, Frey, & Elwardi, 2004, p. 140). This process is vital to the negotiation of one’s own understanding of a concept.
Students also spoke about the use of the SWH student template as a way to record their thinking during science investigations. A 5th grade girl described the use of the template during her recent science investigation regarding sound:

Mostly we write down our beginning idea, which is just what we think. Then we do (write) our procedure-our lab…what we do to “See what happens”. Our observations are what we heard or saw. Then we make a claim and write our evidence.

As indicated earlier, the work of scientists is heavily invested in reading and writing. When students use the SWH template they are writing to learn in a focused manner. Using the template allows students to negotiate their understanding individually and/or with their small group before engaging in discussion with peers and sharing their claim and evidence.

ARGUMENTATION AND PUBLIC NEGOTIATION AS LANGUAGE TOOLS FOR LEARNING

During the sharing of claims and evidence, students are engaged in yet another aspect of using language to learn, that of argumentation and public negotiation of understanding. While discussing claims and evidence in this classroom, the teacher is particularly mindful of students who may be negotiating their understanding privately, but are not sharing their thinking aloud with other students. She uses “Pause and Reflect” as an opportunity for students to stop talking and record their thoughts. By using “Pause and Reflect” the teacher invites students to “compose their thoughts and take stock of their beliefs and opinions before engaging in (further) discussion” (Fisher, Frey, & Elwardi, 2004, p. 151). In the words of a self-described “quiet” 5th grade girl:

Sometime we have a big discussion and some people don’t get to talk and then we write down what we are thinking to see if what we thought is what we still think. We use it so we can understand what we are thinking. If you are a really quiet person and you can’t talk because everyone is talking, you get to write it down. Sometimes I don’t talk, but I pause and reflect to think about my ideas.

This student showed me two pages of writing she had composed during “Pause and Reflect”. It was an amazing explanation of her thinking! Without this opportunity to write, both she and her teacher would not have known the depth of her understanding related to the concept. Even though she chose not to publicly negotiate her understanding by speaking, her writing could lead to a public negotiation in the form of summary writing at the end of the unit.

SUMMARY WRITING

Thus far, we have been exploring the ways in which students use language to learn for the purpose of negotiating their own understanding and with the primary audience being themselves. The writing format varied from “writing in a non-fiction way” to “using the SWH template for labs” to jotting down ideas from “Pause and Reflect” to the use of the concept map.

Another key piece of using language to learn within the SWH approach is for students to engage in summary writing to an audience other than themselves or their
teacher. The reading and writing that students engage in throughout the SWH process becomes the catalyst for this summary writing experience. Let us think back to the beginning of this chapter. Students were writing “in a non-fiction way” in their notebooks. Students made the connection between reading and writing and demonstrated this in their “new” way of writing. This writing then can be used and expanded on in summary writing. It is the act of summary writing (particularly to a younger audience) that consolidates students’ thinking around the big idea. Examples of summary writing include, but are not limited to: writing letters, creating books, making field guides, brochures, and writing poems. For a more complete list of ideas for summary writing, please see Chapter 8 of *Questions, Claims, and Evidence* (2008), by Norton Meier, Hand, Hockenberry, and Wise.

Not long after visiting the classroom described above, I had the opportunity to talk to students in another 5th grade classroom about their summary writing. These students had just completed a unit centered on the human body. As a part of this unit, they had completed multiple investigations and read many, many non-fiction books to find out “what others say”. They too had compiled information about what non-fiction writers did to help their audience understand their message. They were particularly intrigued by “ABC” books and decided to write their own Human Body ABC books for summary writing (See Figure 1-3).

Here is how one young lady described what she learned while she was writing her ABC book:

I didn’t know how I was going to find words for each letter of the book to describe the human body till I started looking things up. For example, I learned a new word, “zooist”. Also, our big idea is that Systems work together, and. And they work together very fast. Like your mind…when you have your hand over the stove, it’s very hot. Your brain sends a signal to your hand to move through the nerves and right back. It’s very fast, lightning fast—very cool. I do love science.

She went on to talk to me about every page in her book at rapid fire pace. She was very proud of her writing and was excited to have the opportunity to talk about her book. What was exciting to me as I listened to her was not only what she had

![Figure 1-3. Gastric juices break down the food you just ate.](image-url)
internalized about the human body, but the excitement she had about writing, science, and her learning! Writing was not a “chore” or “just another thing” she had to do for school. She used language to learn and became an author in the process!

**USING LANGUAGE TO LEARN IN PRIMARY GRADES**

You may be thinking right now, “Ok this is all well and good for upper elementary students, but what about younger students. How do they use language to learn?” Answering this question causes me to smile. My journey first as a teacher and then as a literacy consultant has taken me along many paths and through many different grade levels. In addition to teaching students in upper elementary as I mentioned earlier in this chapter, I spent three years teaching preschoolers with disabilities and one year each teaching students in kindergarten and first grade. Young children are constantly using language to learn. They negotiate their understanding by speaking. They ask questions constantly. They say “You know what”, and happily explain to you and to anyone who listens their new understanding of the world. They listen to books and to explanations from their friends, their teachers and their parents, and add to their understanding. They write and draw to make sense of their world. As they write, they are consolidating their understanding of the world while using language to learn. To illustrate this, let’s visit a kindergarten classroom.

In this particular visit, which took place in a two hour time period, I had the opportunity to witness what I would call an “explosion” of students using language as a tool for learning. In this kindergarten classroom the teacher had just started a unit centered on the big idea that “Living things have characteristics that make them different from non-living things”. She and her class had listed on a large white board items that fit their current understanding of “living things” and “non-living things”. Looking around the room, I could see that she had many, many books in her classroom for students to use to consult the experts and she told me that she had encouraged students to read and then write what they had learned. While students were working, the teacher began conferring with individual students to ascertain their beginning understanding about the big idea. She called each student to a quiet spot in the room and asked questions. The conversations went something like this...

Teacher, “Let’s talk about living and non-living things. What’s your claim about a tree?”

Student, “it’s living.”
Teacher, “What’s your evidence that a tree is alive?”
Student, “It grows.”
Teacher, “What’s your claim about a chair?”
Student, “Non-living.”
Teacher, “What’s your evidence?”

To this the student did not respond and simply shrugged his shoulders. The teacher probed further and it became clear that the student was not sure why the chair was non-living. He looked at the teacher’s chair and at the other chairs in the room. Skillfully, the teacher probed, “What do you think?” Together they talked more about the chair and determined it couldn’t move by itself, so it must not be living.
Each student she interviewed had varied responses. Students were very early in their investigation and were still negotiating their understanding as evidenced by their responses to her.

As I listened to the interviews I glanced around the room and saw that the students who had been reading books were beginning to write on the large white board. I went over and talked to a young lady who was busily writing (See Figure 1-4) and said, “Tell me what you wrote…”

She said, “Raccoons are living. Birds are living and rabbits are living.”

I probed further asking, “How do you know?”

She responded, “I know raccoons are living because sometimes when my mom is driving I see raccoons on the road. They move with little feet. Birds are living because they have special parts to move like wings and feet. Rabbits have parts to move with their back legs. I saw some at my house when my brother was shooting birds.”

Intrigued by the ways in which she was writing to learn as well as talking about her learning, I smiled at her and sat down with my computer on my lap to listen and engage in one of my favorite activities “kid watching”. Students began coming up to me and showing me their books. “Look at this kitten. It’s alive... I have a kitten...Do you have a kitten?” said one little girl. One of her classmates who wanted his turn to talk to me said, “Cats are alive, cause I had a cat in my backyard by my dad’s old truck. We have cats that don’t die.”

Figure 1-4. A young child writes her claim on a white board.
As I continued to watch and listen I noticed that several children were picking up small white boards and writing what they were thinking and learning. A young girl sat down by me and drew three columns on her white board. The columns said, “Living, Non Living and?” Puzzled I asked, “What’s the question mark for?” She said, “Well, if you don’t know if something is living or not, you put it in the question mark spot.” Then she began writing. (See Figure 1-5). She said, “A person is alive cause it can move. A car or truck is not alive cause it can’t move by itself. A Barbie I don’t know. It could be alive and maybe it isn’t alive. I just don’t know.”

These types of conversations continued for the half hour I was able to stay in this room. I looked up at the large white board as I stood to leave and realized that many students had been writing their claims about items that were living and non-living and some were even beginning to write evidence statements. One group of two children wrote, “Cows are living clos (cause) they eat.” Reluctantly, I left the classroom and went to my next appointment. An hour later, the kindergarten teacher stopped me outside her room and said, “You have to come see what has happened.” Her entire white board was filled with writing!

It was truly an explosion of using language to learn about science. Students were reading, asking questions, sharing claims and evidence with their teacher, with me, and with their classmates. They were writing, thinking, reading, and writing more. All of this occurred because the teacher purposefully set up an environment in which students were in control of their learning and could negotiate their understanding by using language to learn about their world and their big idea.

Figure 1-5. A young student uses writing to organize her thinking.
Think back to the examples from 5th grade at the beginning of this chapter. What are the connections between the two in terms of using language to learn? In both cases, students were exploring their understanding by using language to learn. In both cases students were reading, writing, speaking, and listening. In both classrooms students engaged in writing in “non-fiction” ways. Kindergarten students were using cause and effect statements. 5th grade students used concept maps to show the connections between their ideas. Kindergarten students drew two and three column charts and worked to complete them. 5th grade students used other features of text such as bold print and illustrations. Kindergarten and 5th grade students read and wrote to gain understanding of the science concept. They had a purpose to read and a purpose to write. In much the same way as the lab scientist Shanahan (2004) described, they were using language to negotiate their understanding of science in purposeful authentic ways!

To understand further how primary students use language to learn I want to share an example of a first grade student who was participating with his classmates in a claims and evidence discussion after an investigation. In March of this year, I observed this young man for the first time. Thomas had large brown inquisitive eyes and an infectious grin. I was invited to participate in the circle conversation held by the students and their teacher. One by one each student shared their claim and stated their evidence for their claim. After each claim, students were asked if they agreed or disagreed with each claim and to explain their thinking. After the first student made her claim, Thomas said while nodding his head up and down, “I disagree”. The teacher said, “Can you please tell us why?” Thomas said, “Because my claim is exactly the same.” The teacher said, “Oh, you mean you agree.” Thomas said, “That’s right, I disagree with Shannon” all the while nodding his head up and down vigorously. After each claim, this conversation was repeated until all the students said, “No, no, you mean you agree.” Smiling, he said, “That’s what I said, I disagree”.

Clearly Thomas was just beginning to use the language of negotiation and the terms “agree” and “disagree”. After class, the teacher and I discussed Thomas’ conversations. We both agreed that Thomas needed time to further negotiate his own understanding of the differences between the two terms “agree and disagree”. His classmates tried to help him understand the differences, as did his teacher. Thomas however, had not yet come to understand. He was determined to use his current understanding as he participated in the conversations. As I drove away from the school that day, I carried a bit of Thomas with me. His smile, his determination to use the language that his classmates were using (even though he did not have operational understanding of the words “agree” and “disagree”) was a true example of how children use language to learn.

Almost exactly one month later, I had the opportunity to again observe Thomas in his classroom. The students were seated in their conversation circle sharing claims and evidence. I was excited to see what would happen this time. A young man, Sam, shared his claim and evidence first. Immediately, Thomas began to talk.
"I agree with Sam", he said smiling. "Sam is right; cats do have a life cycle. They are born, they grow, and grow and then eventually they die." His teacher looked up at me and we both smiled. We had evidence on which we both could agree. Thomas now understood the difference between the words “agree” and “disagree”.

Through the writing of this chapter, I have tried to share with you examples across grade levels of how students use language (reading, writing, speaking, viewing, and listening) to learn. There is no Science without language; of that there is no doubt. When students are given opportunities to negotiate their own understanding of the world around them by using language to learn, they are truly apprentices on a journey to becoming lifelong learners who will become “informed consumers” and “engaged citizens” (Shanahan, 2004).

CHALLENGES AND HOPES FOR THE FUTURE

The challenges for the future are, in my opinion, opportunities more than challenges. Currently teachers around the world are using the SWH approach. The opportunity we have then is to negotiate our mutual understanding so that we can provide even greater growth in students’ conceptual understanding. Negotiation around our mutual understandings will be critically important as we continue to share this approach with more and more teachers and their students. Since we believe that students use language to learn, we will need to think about ways that we can provide more opportunities for students to negotiate their understanding by using language. Questions include:

– What additional tools and resources could teachers use?
– How can we better utilize concept maps, the SWH template, reading frames, student notebooks, and non-fiction print to provide opportunities for students to negotiate understanding?
– What skills and strategies do teachers need to facilitate argumentation in their classrooms?
– How can we better help students use language to learn as they participate in argumentation?

As we move forward and share the approach with more teachers, negotiating our understanding about these and other questions will be critical to improving practice.

Certainly, my hope is that every teacher will embrace the philosophies of teaching and learning that are central to the SWH approach. We know from the tremendous amount of data collected and analyzed in SWH grants, that when teachers approach their classrooms as places where students are in charge of their learning, and provide students with daily opportunities to engage in using language to learn, tremendous growth occurs for all students. Those of us who have worked both as teachers and consultants on this project know first-hand the benefits. We see the excitement, the joy of learning, the engagement of students who want to read, write, listen, view and discuss, and we want these experiences for all students. I believe that Thomas would say, “I agree.” Do you?
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2. NEGOTIATION

Why Letting Students Talk is Essential

Come take a walk in my classroom. I have the students’ desks in groups. There is a concept map on the whiteboard. The typed list of student-generated questions is posted on the board. A pile of nonfiction books lay on the table. The tall stack of science journals is waiting to be checked.

This was not the way my classroom looked before I learned about a new approach to teaching science called the Science Writing Heuristic (SWH) six years ago. I was the typical science teacher. I was a new teacher that let the textbook drive my instruction. I used worksheets for students to provide answers to questions about what we read. Maybe I used an occasional lab, but it was highly structured and I was looking for everyone to reach the same answer. I was also apprehensive about teaching science.

Before learning and using the SWH approach, I didn’t enjoy teaching science. It was probably my least favorite subject to teach. I truly felt I was not smart enough to teach the topics I needed to teach in upper elementary. I wondered if I truly understood the concepts. What if a student asked me a question and I didn’t know the answer? I would be horrified! I certainly didn’t encourage students to ask me questions for this very reason.

This is not my classroom today! The textbook is only a resource. We seldom, if at all, do worksheets. My labs are not as structured, and I am elated when students reach different claims on a lab. This makes for terrific debate. Questions are now an essential part of the way I teach science. I realize that it is OK not to know the answer. I can learn with my students, which I do, and teach them ways to locate the answers to their questions. These changes in my instruction did not come easy, nor did they all come at once. It took time and a lot of trial and error. I constantly learn with and from my students.

The focus of this chapter is negotiation. What is negotiation? When does it happen? It happens each day in my classroom and not only during science class. It might be students negotiating with themselves inside their head. It might be students negotiating with other students verbally. It might be students negotiating their own understanding through writing.

What is negotiation? Negotiation is trying to make sense of what you know. Combining what you think you know and listening to what someone else is saying and coming out with your interpretation or understanding. It is questioning your
own thinking or the thinking of others. There are several places negotiation happens in my classroom, and each way will be explained.

CONCEPT MAPS

Concept maps are an excellent tool for negotiation. I use both individual and class concept maps. Individual concept maps are good for self-negotiation. Students need to think about what they know about a topic and how it all fits together. I usually have students make an individual map first. This way everyone has time to think about what they know before we move into the class map. It is important to give students this time to self-negotiate before moving to the whole group. This gives students time to think about how the topic or unit connects in their mind.

When the students are constructing the class concept map the discussion can get pretty heated. Some students are sure they know what they are talking about, but others have no idea. Sometimes a word gets thrown around, but no one knows how to connect it to the bigger picture of the unit of study. There are times when the class just can’t agree on how a word fits on the map so it ends up in the “don’t know” box until it is determined later in the unit.

I learn a lot during these discussions. I learn who has a lot of background knowledge on the subject. I learn which students might need extra support as the unit progresses. I can discover which students might need to dig deeper into the content to find things that are new to them. I find out what misconceptions the students have. I can tell which students have the right words but have no idea what they mean. I hear questions that are brought up. This is not a time for me to sit back, but instead I am making lots of observations and in a way “taking notes” to know what I need to do next and how I will get there.

Students enjoy watching the concept map grow as we progress through the unit. It is a perfect place to show how our ideas change. What they thought they knew at the beginning of the unit sometimes isn’t exactly true. At the end of the school year, it was time to erase our class concept map on the human body. This was the first time during my six years that students asked if they could take a picture of it. I said yes, and before I knew it about six students took out their cell phones and started snapping photos. It showed me that they were proud of their learning.

MY STRUGGLES WITH CONCEPT MAPS

I didn’t always understand the importance of or even like using concept maps. They took time, and it was a hassle to find a place to hang it. When I used sticky notes they always fell off. I was unsure of how to handle disagreements between students about where to place words on the map or which connection words to use. Sometimes the knowledge is so varied from student to student that it is hard to come to a class consensus and know how to best construct the map. I thought it might be easier to just avoid the issue. Plus I would forget to come back to the class concept map to revise or add. It seemed like just something I was supposed to do rather than a teaching tool. Couldn’t I get the same information from a KWL?
But my problem with KWL’s is that I seldom remembered to have students fill in the “What I Learned” column at the end of the unit.

My experience with concept maps is different now. Once I started using them on a regular basis, I found they help students. They gave my students a way to connect their ideas and explain what they knew, instead of just random words about a concept or idea, which would be a word web. And once the kids got hooked, it was easy sailing. My students loved watching the concept map grow during the unit! I realized that the individual students would have varied knowledge, but that was positive because it led to stronger debates and more negotiation.

It is hard not to persuade students’ thinking during the negotiation of the concept map. It is another example of a time when I just have to be quiet and let the students take charge. It is their thinking and not the teacher’s ideas. When my class made a concept map of the human body the word circularity system was mentioned. Every student in the class called it the circularity system. It wasn’t easy for me to write or say that word knowing it was incorrect, but because I knew it wasn’t my map and had to go with their word. It stayed on the board wrong throughout the unit it was finally discovered by a student that the system was actually the circulatory system. I knew the students would eventually notice it, but I needed them to point it out.

BEGINNING IDEAS

When my students are first given a question for a lab, I have them write down their beginning ideas on what they think the answer is. I didn’t do this my first few years, but I found that students need time to think about what they know or what they think the answer to the question might be. I also ask students to reflect on how their ideas have changed, and I found that if they didn’t take time to write down their beginning ideas it was hard to reflect on how their ideas changed. I was displeased with a lot of reflections because I knew the response I would get was “My ideas didn’t change”. Well, for most students I knew that wasn’t true. At first I thought it was just a way out of having to write or a way to make it look like they always knew the correct answer. After reflecting on this issue I came to realize that it might be because they truly did forget what they originally thought. I thought it would be beneficial to write down beginning ideas so students could have a reference point. Also, I feel it is a way for students to commit to an idea. It is easy for students to just say, “I don’t know.”

IT IS OK TO SAY, “I DON’T KNOW”

This is another issue that I have struggled with. Do I let a student write, “I don’t know”? At first I said yes they could write that, but after thinking about it, I have changed my mind. Again I don’t want them to take the easy way out. I want students to think, but on the other hand I also know we study some topics the student will have little prior knowledge. My point is I want students to think about what they know. It’s too easy to say, “I don’t know”. I want more than that! I feel there is little to no negotiation if I say it is acceptable to write I don’t know.
Once students have self-negotiated, they share their ideas in their small group before beginning their lab. Now we are moving into group negotiation. Students talk about their ideas and now have to think about the ideas of their peers. Do I agree with what she is telling me? Do I understand what he is saying? How does what I am hearing fit with my current understanding or knowledge on the topic? This student-to-student conversation is critical in my classroom. For students to be able to share their ideas and learn from other students is far more powerful than when the knowledge comes directly from me.

After students have completed a lab they are asked to look at their data and observations and make a claim to answer the original question. This claim is to be supported with evidence from data and observations. Again negotiation is important in this step of the SWH approach. First students must self-negotiate. What is this data telling me? Can I support that claim with evidence? Students also listen to the ideas of the other group members and ask themselves if they agree or disagree with the idea. Once again communication is the key.

STRUGGLES WITH CLAIMS AND EVIDENCE

Part of my struggle has been with posing the right question. I have an idea of what knowledge I want students to come out with, but I struggle with aligning the question so those ideas will come out right. I also don’t want the question too limited that might cause all groups to come to the same claim. That hasn’t happened much for me, which is great. What causes much debate is when two groups have contradicting or opposite claims. It is even better when a student points that out!

I have also found that it is hard for students to make claims. This might sound funny because they are always making statements, but when students have to look at the data and make a factual statement I have found this to be difficult for them. Partly because some of the students might already think they have an answer to the question, but it is more of prior knowledge than a claim they can support with evidence from the lab they completed. For example, my class completed a lab on blood types. This is one of those labs where I struggle to post the question correctly. The question I asked was “What can happen when two bloods are mixed?” One boy couldn’t agree with his group and decided to write his own claim, but it was his prior knowledge and didn’t come from anything his group did in class. He was trying to make a claim about genetics. Well, there was absolutely no evidence from our lab to support his claim. I have found in my six years that the gifted students struggle the most with claims and evidence. They are certain they know the answer, but when asked for evidence they struggle to provide it. Learning has come easy for those who know the answers or were able to memorize everything after hearing or seeing it. The SWH approach to learning asks the student to think critically and not just memorize.

They also confuse claims and evidence. In their science journals, we write the definition of both. A claim is a scientifically based opinion. Evidence is data that supports your claim or answers the original question. It comes from the observations during the lab. I didn’t always do this, but have found it beneficial for the
students to reference these questions. Many times students referred to that during
debates.
Elementary students can really debate ideas. Science debates are the best part of
the entire SWH approach, and a time when I have to close my mouth and listen.
Believe me that was not easy to do when I first started this approach to teaching
science. Actually, it still isn’t, but I have witnessed the benefits of staying out of
the conversation. This helps remind me to close my mouth! It is not just a time to
sit and do nothing, but instead, it is a time of considerable observation and learning
for me as the teacher.

REASONS TO LET STUDENTS DEBATE IN THE CLASSROOM

I learn so much from student debates. I can tell which students “get it” and which
ones don’t. I take note of what misconceptions are lingering in their minds. I can
learn where we should go next or what the next lab or activity should be. I want as
much student-to-student talk as possible. Watching my student do this is the highlight
of my day, and for the last six years, it is also the favorite part for my students.
They are given an opportunity to talk. How often do we ask students what they think
about a question or idea? How many teachers want to know what their students think?
This goes far beyond a simple KWL chart. Student talking is the backbone of the
way I teach science.

My students can hold an hour-long debate and sometimes we will only discuss
three claims. There are times when I might not say anything for ten minutes and
believe me the room isn’t quiet either! I enjoy watching students use higher order
thinking questions with each other. They address a certain student to ask them a to
clarify something said or directly ask them a question. This is when I know that these
debates work. When they start to ask other students what do you think, Joey? I’m
in awe. I even wonder sometimes if they need me anymore. This is where I want them
to be able to hold a debate amongst themselves. Not only in science, but in all subjects
and even outside of the classroom.

STUDENT EXAMPLES

Shy Girl Speaks Up

It was neat to see the quiet student confidently tell her classmates I think we are all
wrong. I think light bounces off everything otherwise we wouldn’t see anything.
She was right, and it took her courageous statement against the other claims to change
the course of our conversation. The conversation moved from “Only shiny things
reflect light” to “Oh, she might be right!” I wanted to scream yes! You go girl! I am
proud of you for going against the ideas of the class. It is easy to go with the flow.
Students agree to what the majority of the class thinks or the students that are viewed
the “smart ones”. I could tell she had been listening to the ideas of her peers and self-
negotiating. Something just wasn’t fitting with what she was hearing, and she voiced
that to the class. This made the class self-negotiate. Some students began saying
Oh, yah. I remember reading that in a book.
No Conceptual Understanding

Another example happened during a lab on the respiratory system. Students had completed the lab, written claims, and we were in the middle of the debate. Students had made a model of the respiratory system using a water bottle with the bottom cut off, balloons, straws, tape, and clay. Students knew that the bottom balloon was important in making the lungs expand and contract, but they didn’t know what that bottom balloon was in the body. Sometimes students think they know a lot about a topic as in this case with the respiratory system. A few of my students could rattle off the words like lungs and diaphragm, but once other students questioned them, it was revealed that it was just surface level knowledge. No conceptual understanding was there at all. They knew there was a diaphragm, but not a one of them connected that to the bottom balloon. Too often students can say the right things so teachers think they understand it, but this case shows they may not. It just took a few questions to find out they didn’t know how the respiratory system worked. This supports the idea of why we need to question students.

Connecting to Past Learning

A third example came from a bright student. He offered the idea of a third lung. He said that maybe that bottom balloon in the model of the respiratory system was a third lung. You might imagine there was quite a bit of buzz in my room about that comment, but it again caused students to negotiate. They came to the conclusion that no one had ever heard about our body having three lungs. Someone else commented that maybe it was a muscle. She said, “You know we just learned about muscles and muscles pull. Maybe that bottom balloon is a muscle.” WOW! This is a teacher’s dream. Someone is connecting previous learning with something new. It wasn’t just taught, tested, and forgotten. She had actually learned that. Muscles pull! Another moment when I just wanted to go up to her and give her a big bear hug and scream Yes! I love moments like that. After six years of teaching with the SWH approach, there are more of these moments each year.

Why You Should Question All Answers…Even the Right Ones

I learned the importance of not only questioning wrong answers, but to question right answers too. I was teaching a language lesson on compound words. I wrote a variety of compound words, some as one word, some as two words, and others with hyphens. I asked the class to figure out what the words had in common. Students first thought alone, then were asked to confer with their group members. Once groups had their ideas we shared out. When the idea of compound words came up, I asked a student, “Really, I thought compound words were just two words put together to form one word?” She instantly doubted her answer and said that now she didn’t know. No one else now wanted to say they were all compound words. I found it intriguing that the minute I questioned her answer she had little faith in her answer.

I thought that I had learned to do this, but obviously I still need practice. During one math lesson, a student asked me why I only questioned wrong answers. I made
a point to question all answers. If you don’t, the minute you question them, they
know their answer is wrong. It takes students a while to get used to this, but once
they do I believe it helps strengthen their understanding if they can tell you how
they reached the answer in math or why they think something is true. One critical
thing I have learned is to question wrong answers as well as right answers.

*Students Actually Learn if We Just Tell Them*

Something I learned recently is that it is hard to change someone’s thinking. We
did a probe about an apple in the dark. Students were given a scenario about an
apple being in a room with no light. Students first self-negotiated and chose one of
four answers and why they believed that was the correct answer. One answer was that
you would not see the apple regardless how long you are in the room. The second
choice was you would see the red apple after your eyes adjusted. The third choice
was you’d see the apple after your eyes adjusted, but not the color. Fourth choice
was that you’d only see the shadow of the apple after your eyes adjusted. The last
choice was you would see an outline of the apple after your eyes adjusted. When
I walked around the room, I found it interesting that only one person had chosen
the correct answer- you wouldn’t see the red apple no matter how long you stay
in the room. We had already had a lab on light and researched what the experts
said. They could tell me that light was needed to see objects, yet they weren’t
connecting that learning to this probe. I was somewhat baffled, but knew it would
turn out all right in the end. However, I did wonder how our debate would go if
most people had a similar idea, and the idea was wrong. Would there be any debate at
all? Would the one student with the correct idea state her opinion when it was the
opposite of everyone else in the class? We moved right along and started sharing
ideas. I have found that if you give students time to talk they will talk. I have never
had a problem with students talking. Most students like to share their ideas.

*Fifth Grade Students in Action*

Here is a real example from a science debate in my fifth grade classroom. They had
completed a lab to answer the question “How does the Respiratory System Work?”
Each group had made a working model of the respiratory system and then written
a claim supported by evidence. The class was now sharing claims and holding a
debate. During this discussion, two groups had opposite ways to inflate the lungs.
Also, no one seemed to know what the organ in our bodies the bottom balloon re-
presented. Names have been changed. Please notice I said nothing throughout the
entire discussion, which lasted for thirty minutes. Math was the only thing that stops
the debate!

Emily- No one really knows for sure what this (bottom balloon) really is. I agree
with Katie. It doesn’t matter what this is or that is, pointing to parts on their model.

Kate- It’s just a model. It’s not like were looking in our body.

Brad- I disagree. We have something that helps our lungs, but they’re saying the
bottom balloon doesn’t matter.
Chris- So are you saying it matters because it’s part of how it works?
Brad- Yes.
Chris- I agree with that.
Kate- I think the bottom balloon does matter. But I think the actual bottle doesn’t matter.
Faith- If it doesn’t matter what the parts of our model are, how are we going to figure out how the lungs work?
Cole- If you think the bottle is ribs, they- the ribs and lungs- don’t work together. The ribs just protect the lungs. Lungs- ribs- two separate things!
Chris- So are muscles and bones, but they work together?
Mike- Are you sure about that?
Kate- I think the bottom balloon matters but we don’t know what it is! The bottle is just a bottle.
Brad- So you’re saying we have a bottle in our body?
Kate- No, I’m just saying it doesn’t matter what it is.
Glenda- Why not?
Emily- I agree with Kate.
Kate- It’s just a bottle. Why does it have to represent something?

Knowing When to Stay Out of the Conversation

As you read above, I didn’t have a part in their debate. This wasn’t always the case, and it didn’t start out easy. We as teachers want to be in control. It is after all our classroom. We are the teacher, and it is our job to teach our students, right? I have found that if we add our two cents into the debate then our students think what we say is true. That might prevent them from sharing what they are thinking, especially if it is different from what we stated.

It has taken me six years to feel comfortable letting students take the lead and debate without me. It’s not that I never speak, but I have learned when it is appropriate and when it might hinder the conversation between students.

So when do you as the teacher jump into the debate? If so many students are talking at once, I will enter the conversation to remind students that only one may speak at a time. I had jumped in when I thought students needed some time to “chill out” and think for a minute. Sometimes our debates get pretty heated. When a student starts to get defensive, I jump in to remind them that we are disagreeing with an idea and not the person. I also might pose a question if I feel students are missing something valuable or if we have gotten off on a tangent.

I have also learned that some of the best debates can come from a tangent. It’s hard to know when to bring them back to the main topic, but it’s OK to let them share what they know. It’s all a matter of the teacher’s comfort level. After six years, I am comfortable with letting them veer off track a little. In my first few years, I would have jumped right in and brought them back to focus on the topic. I felt insecure or I was losing control of my class. There are still many times when I want to add a comment, but I just wait for a student to make that point. Usually if I wait long enough a student will say what I wanted to and I would much rather it come from a student.
HOW TO ADD WRITING TO SCIENCE CLASS

Pause and Reflect

This is a writing strategy I recently starting using. During our debate I have certain students who dominate the discussion, and I have others that feel they can’t jump in and give their opinion. Or at times during the debate it was obvious that there are two or three main ideas about one concept. This is when I use what I call pause and reflect. It is just what it sounds like. Students pause from verbally giving their ideas and take time to reflect or self-negotiate. They retrieved their science journals and began to write. This was a great opportunity to let everyone have a voice. Sometimes I gave the class a question or topic to write about, like “What is the color of blood?” Other times I just asked them to reflect on what they heard that day. It is a timely tool to use if we are in the middle of a serious debate but need to stop due to time. Students read their reflection at the beginning of our next science class. Students used to grumble when I would ask them to stop and pause and reflect. But now I think more of the students like it, especially the timid ones who don’t have a chance to jump in the conversation and add what they are thinking. As a teacher I like this strategy because it reinforces the writing aspect of science. It shows students that writing is a form of communicating our ideas. Some students can share their ideas easier on paper.

Reflections

At the end of a lab, I ask students to write a reflection of how their ideas changed over the course of the lab and what they learned. This is metacognition or thinking about your thinking. Students self-negotiate to think about how their thinking changed. Students think back about their ideas in the beginning, throughout, and now. This is why it is vital to have each student write their beginning ideas and to take time to pause and reflect throughout the unit. Students can go back and read what they were thinking. Metacognition is not an easy task and some kids struggle, but it is so essential to be able to put on paper what is going on in your head. I do not use this as a time for students to point out who was right and who was wrong. I stress that these reflections are to show our learning throughout the lab and unit.

Create a Page of Non-fiction Text

I use this occasionally at the end of a lab as a different way to assess if students understand the main points from the lab. It is a different way to have kids negotiate meaning. Earlier in the year we looked through non-fiction texts and made a list of all the different text features authors used. I connect that language skill to science writing. Students are asked to create one page of non-fiction text using text features we discussed. This text would show what they learned from the lab. Some of the students that were not excited about writing reflections, quickly started this task. Some students even made more than one page! When everyone is done, we have a gallery walk and read each other’s pages. It is time for a negotiation. I have heard students
say they thought that the information another student had in their page of text was wrong. After a gallery walk, it was noticed two students had the same fact, but the number of minutes it took sunlight to reach Earth was different. This started a debate in my room. These students went back to their source, and one realized she had written the wrong number. This was all from the students. They knew to go back to the source as I had taught them. This would not have been as powerful if I as the teacher had pointed out the wrong fact or simply written a comment in that student’s journal. The fact that a student pointed out the difference and then the students went back to the resources to settle the conflicting data was exciting.

Not Just for Science

After using the SWH approach for six years, I find myself using bits and pieces in other subject areas. Even though this approach is called the Science Writing Heuristic, it can be used in all subject areas. I want my students to question ideas, think critically, share their opinions, make connections, and support their claims throughout the day, not just in science class. Therefore I use claims and evidences in reading. I have written claims on a quiz or worksheet and asked students to provide evidence to support it. Talking and debating isn’t just saved for science class, but woven into the entire day. In reading, we have literature circles over the novels we read. Students can easily hold a thirty-minute discussion over two chapters. It goes beyond the typical summary type discussion. They use some of the same language they use in science. Phrases like these are common- I don’t agree with that! Why do you think that? That’s not what I think!

Set Expectations Early

When students are allowed to discuss, and in my classroom are highly encouraged to, it happens naturally. One reason this happens in my classroom is because from day one it is my expectation. Students know they will be expected to give their opinion in my classroom and give reasons or evidence for what is said. In my classroom, we don’t post rules, but instead we have rights and responsibilities. It is a student right to voice their opinion and a responsibility to listen to others ideas. I set up my classroom to encourage discussion. Again, my desks are seldom in rows, and sometimes desks are even pushed aside so the chairs can be arranged in a circle. This makes student-to-student debate easier. In fact, the students ask me if they can arrange them in a circle during debates. It is hard for students to interact when desks are in rows. Simple things like the way the desks are arranged in your classroom can encourage or hinder student debate.

SUMMARY

If I had to summarize this chapter in just one sentence it would be “get students talking and writing.” I may have a noisy classroom, but there IS learning taking place. Don’t be afraid to give up a little control. What a student learns doesn’t have to
come from the teacher. Students learn by doing. Students learn from listening to their peers. Students learn by reading from experts and realizing what they thought they knew was incorrect. Students learn from talking to other students, students learn from writing.

I tell my students I am not the “giver of knowledge”. I provide opportunities for learning and my students love science! I didn’t hear that ten years ago. Students want to be involved in their learning. Students want to be engaged in the unit. Students want to share their knowledge on a subject.

One student wrote in my scrapbook this year- Thank you for making science my favorite subject instead of my least favorite subject. This statement made an impact on me because this is the same for me. Thanks to the SWH approach, science has changed from my least favorite subject to teach to my favorite subject to teach.

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