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Factors That Influence Your Science Teaching Philosophy

Focus Questions

- Why teach science to young children?
- Who are you, and how do you feel about science?
- What are your views of science and scientists?
- Who are your students?
- How can you help your students succeed in science?

The increasing number of children from diverse cultures entering U.S. schools, combined with the national goal of scientific literacy for all children creates a major dilemma for teachers who belong to cultures that are very different from the immigrant cultures. The emerging body of literature suggests that children from different cultures bring alternative ways of knowing, communicating, and experiencing the world, which may be incompatible with the way science is traditionally defined and taught in our schools and addressed in the state and national standards. This book begins by examining equity and access issues that have a major impact on science teaching and learning. During this in-depth investigation and reflection, you will examine the following two student-focused questions:

- Who are your children?
- What are their lives like?

Concurrent with this process of discovery about your children, you will also engage in an in-depth self examination and reflection of yourself and your often subconscious expectations for all children. The final self-reflection leads you to examine the question:

- How does knowing who you are and who your children are make you a better teacher?

Once you come to a better understanding about who you are and what culturally embedded issues your children bring to the classroom, you can move on to dealing with your scientific self and examine your views of science and scientists.

Throughout this book, you will find many reflective activities and be guided to collect many resources. Keep your reflections or entries in this book or in a journal, and file any research that you do online in a folder that you can use for reference in your curriculum planning and development.

Why Teach Science to Young Children?

Teacher Activity: Initial Reflection

List three reasons why you should teach science to children.

1. _____

_____

2. _____

_____

3. _____

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As we enter the era of global warming, decreased food supplies and increased cost of energy, we become more aware of the importance of science and technology and the need to have our population capable of making decisions informed by scientific knowledge. At the same time, there is compelling evidence that only a small percentage of the children who pass through the school system develop any useful scientific literacy. We continue to produce graduates who lack even a basic understanding of science and technology, who have a negative attitude toward science, and who have not fully developed critical thinking skills capability. This paucity in science knowledge has increasingly unfortunate personal, social, and economic consequences, including the inability to take pleasure from the natural world, to make decisions that contribute to the sustainability of our environment, and to use science to inform decision-making processes. The increasing technological sophistication of the work place will require at least a basic knowledge and skill in science, mathematics, and technology.

Personal and civic decisions are often better made if guided by scientific knowledge. For example:

- When states propose shipping their garbage to other states or to remote areas in the state, can residents offer a better alternative?

- As new diet fads wax and wane, how do people sort out the competing claims and choose a safe method of losing weight?
- As the cost of gasoline rises each day and energy consumption becomes more and more of an economic issue, how do people respond? What knowledge do they use to guide their decisions?

Scientific understanding alone may not suffice to guide such decisions, but its absence will likely lead to poor solutions.

In the past it was believed that only a handful of smart children had the capacity to learn science while the remaining children—those who are average, and especially those who are poor, female, or in a minority group—are widely assumed to be incapable of learning the math required in science, too concrete of mind to grasp scientific abstractions, unwilling to endure the rigors of science education or do not have the necessary parental support and guidance.

There is ample evidence, however, that the problem is not the child, but instead that science is not being taught or is often taught in a way that progressively diminishes children's interest in the subject and their confidence in their capacity to learn it. For many years, most elementary schools have taught only two subjects seriously—reading and mathematics—on the flawed assumption that this allows them to "leave no child behind."

Even where children are also taught science, the nature of the content and the way it is presented often fail to engage young children's minds. Some young children are taught science as a series of fun experiments; some are engaged in kit-based science. Others are offered "textbook" science, where they are taught facts and concepts but are not given enough time and experience to connect those facts with the realities of the natural world or to grasp the underlying principles that make sense of it all. Thus, children can quickly become bored by the seemingly pointless memorization of content. This type of teaching causes many of our elementary children to be turned off by science. Not surprisingly, many children from all social classes and ethnic backgrounds decide that science is boring and too hard. All children are capable of learning science and should have the opportunity to do so. Science provides them with a foundation for life as critical thinking adults who can contribute to the well-being of themselves and society.

When we consider the question "Why teach science?" it seems easy to answer in terms of the importance of science in society. We can immediately see the multitude of benefits from scientists' research and technologists' application in medicine, industry, transportation, agriculture, electronics, and technology. Think about what your day would be like if all of the scientific advances and applications that have been made in your lifetime alone were

suddenly erased. How very different life would be without television, cell phones, or computers! You need to prepare your young children for a life full of technology, a type of life which has not yet been envisioned. You need to provide them with the skills to exist in that new world—a world in which critical thinkers and problem solvers will be the ones who survive and live successful lives.

The development of critical thinking skills has been emphasized as being of major importance if we want to produce rational thinkers and decision makers who can contribute to society. Great scientists are critical thinkers. The skills practiced by scientists help children become critical thinkers. Critical thinkers

- continually seek to know and to understand
- question all things
- interpret all available data
- base judgment on evidence
- respect logic
- consider consequences of their actions
- demonstrate intellectual independence

These critical life skills should be taught as part of science. For young children, their entire world is their laboratory; they continually seek to know, understand, and question all things. Though their efforts are often fumbling, children readily search for data and want verification. But what happens to their spirit of inquiry as they progress up the educational ladder? Why does the number of questions decrease? Perhaps part of the reason is a lack of opportunity to use scientific process thinking skills or critical thinking skills.

There is no better way to help children satisfy their wanting to know, their questioning and searching, than to allow them to interact with objects and events of the natural world. This is what is involved in their doing science, why it is so important to them, and why you should make it important in your teaching. As a teacher of young children, your major role is to foster and encourage this questioning, this unending curiosity.

Children come to school with a constant need to investigate everything they encounter, but by the end of the third grade this deep interest in science sometimes fades from lack of nurturing on the part of teachers, parents and the community. Our young children, our emerging scientists, only achieve their potential if they receive a high-quality science education. And you hold the key.

Teacher Activity: Why Teach Science to Young Children?

Now that you have read and reflected on the above, give five reasons why you think you should teach science to young children.

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

Now that you have reflected on why you should teach science, let us turn to figuring out who you are and why you teach as you do.

Your Personal Context

Who Are You, and How Do You Feel about Science?

In a recent survey conducted as part of their classroom observation, some of my graduate students examined the status of elementary science teaching in the schools in which they were currently student teaching. Their results lent support to the belief that they do not need to teach science when they have their own elementary classroom. Their results showed that 40 percent of classes had a cluster teacher who was responsible for teaching one to two science sessions per week, 25 percent of classes had teachers who did one to

three science sessions per week, while 35 percent of classrooms had no science instruction. These kinds of results indicate that many teachers may be struggling with understanding that the classroom teacher must teach science as an essential part of a well-rounded education that prepares children to be critical thinkers, problem solvers, and informed decision makers. These results mirror what is currently happening in elementary schools as teachers focus their teaching primarily on mathematics and reading. With the introduction of No Child Left Behind, elementary teachers have had to focus their attention on mathematics and reading, the subjects that were being tested. However, with the recent introduction of science testing, more attempts are now being made to teach science in the classroom. To begin your journey of effective science teaching, you need to start with a clear idea as to where you position yourself in science teaching.

Teacher Activity: Initial Self-Reflection

Reflecting on the following questions will help you begin to focus on your science teaching. Be honest with your responses. No one will see the answers.

1. Can you recall what made you decide to teach young children?

2. What did you think of science then? Did you think it would be a difficult subject to teach?

3. How often are you teaching science now?

4. How are you teaching it? What strategies and resources do you use?

- What is the status of your current science teaching?
- Are you the classroom teacher who teaches science as part of your daily curriculum?
- Do you work closely with a cluster teacher, integrating what you do with what is being covered in science?
- Do you leave all the science teaching up to the cluster teacher?

The answers to these questions will determine how much preparation you need to do to plan for teaching your emerging scientist.

Let us begin this journey by reflecting on you and your in-depth feelings about science and science teaching.

Based on your self-reflection, you might find that you fall into one of these categories:

- did not like science and do not teach it
- loved science and love teaching it
- teaching K–2 because you enjoy teaching young children
- teaching science because you have to

Whatever category you fall into, the exercises in this book will help you develop into an effective teacher of K–2 science. It is important that as you prepare for teaching science, you come to terms with your science teaching philosophy.

The best teachers are the ones who can respect and cultivate individual differences in their students.

What Is Your Teaching and Learning Style?

Here are some questions you may ask and respond to in order to construct a useful picture of yourself as a teacher.

Teacher Activity: What's Your Teaching and Learning Style?

1. Do I plan for what might happen in my class ahead of time, or would I rather cope with problems as they arise?

_____

_____

2. Am I able to empower my students to do science even though I sometimes feel powerless myself?

3. Am I a visual, auditory, naturalistic, or kinesthetic learner/teacher?

4. Under which of Gardner's learning styles (see Table 1.1) would I find myself described?

5. Do I like objective testing tools made by an outside person, or would I rather rely on my classroom interaction to assess my children's learning?

6. Do I use differentiated instruction in my class?

7. Is my classroom teacher dominated or teacher facilitated?

Howard Gardner, in his Theory of Multiple Intelligences, identified eight different types of intelligence: bodily-kinesthetic, interpersonal, linguistic, logical-mathematical, intrapersonal, spatial, musical, and naturalistic. Table 1.1 (page 10) is a brief description of each intelligence based on Gardner's work.

Gardner points out that, in this nation, education usually focuses primarily on linguistic and logical-mathematical intelligence. Intelligence is a mixture of several abilities that are all of great value in life. But nobody is good at them all. In life, we meet people who collectively are good at different things. For further study, it is recommended that you read Gardner's books referenced at the end of this book. You should also visit this Website (http://usd.edu/~bwjames/tut/learning-style/stylest.html) and take a quick test to determine your learning style.

Table 1.1 **Gardner's Multiple Intelligences**

Intelligence	Description
Bodily-kinesthetic	People are generally adept at physical activities (movement and doing) such as sports and often prefer activities that utilize movement.
Interpersonal	This area has to do with interactions with others. People in this category are usually extroverts and are characterized by their sensitivity to others' moods, feelings, temperaments, and motivations and their ability to cooperate in order to work as part of a group.
Linguistic	People with verbal-linguistic intelligence display a facility with words and languages.
Logical-mathematical	These individuals excel at reasoning capabilities, abstract pattern recognition, scientific thinking and investigation, and the ability to perform complex calculations.
Intrapersonal	Those who are strongest in this intelligence are typically introverts, self-reflective, and prefer to work alone. They are usually highly self-aware and capable of understanding their own emotions, goals, and motivations.
Spatial	People with strong visual-spatial intelligence are typically very good at visualizing and mentally manipulating objects. They have a strong visual memory and are often artistically inclined.
Musical	Those who have a high level of musical-rhythmic intelligence display greater sensitivity to sounds, rhythms, tones, and music. They normally have good pitch, and may even have absolute pitch, and are able to sing, play musical instruments, and compose music.
Naturalistic	This intelligence involves the ability to understand and work effectively in the natural world. This is exemplified by biologists and zoologists.

Teacher Activity: Reflection

This reflection provides you with some understanding of your teaching and learning style. It helps you to understand your mindset as you prepare for science teaching and interactions with your students. You need to understand yourself and your teaching style before you can begin to develop plans for teaching your students.

1. Where do you see yourself represented in Gardner's Learning Style Inventory?

2. How does knowledge of Gardner's multiple intelligence help you in teaching science?

3. What are the implications for how you teach science?

4. How does it affect how your students learn science?

5. How will it affect your teaching strategies and lesson planning?

What Are Your Views on Science and Scientists?

Teacher Activity: How Do You Define Science?

1. Science is . . .

   _____

   _____

2. Do you see science as a body of knowledge that has to be memorized? Why? Is this how you were exposed to science?

   _____

   _____

Teacher Activity: Draw a Scientist

Once you have come up with your own definition for science, draw what you think a scientist looks like:

Now consider these questions:

1. What are your thoughts on what scientists look like?
2. What does your drawing reflect?
3. Why do you think that this is your image of a scientist?
4. How many scientists do you know?
5. Do you have friends who are scientists?
6. Have you always avoided having scientists as friends?

During a recent professional development program, I asked teachers to submit anonymous drawings of scientists. Figure 1.1 shows some representations of selected drawings.

These drawings are rarely representative of scientists, although they do tend to perceive the world slightly differently from nonscientists. Scientists tend to try to find responses to the types of questions that your K–2 children are always asking. They are observant, curious, analytical, critical, and objective in their conclusions. In their work, they do not jump to conclusions without first verifying their facts. They constantly use the science process skills.

Figure 1.1 **Teacher Drawings of Scientists**

They are patient, knowing that often it takes a long time to find answers. These drawings represent a naïve view of a scientist; not all scientists work in a laboratory or wear lab coats.

What Were Your Early Experiences with Science?

Teacher Activity: Early Experiences with Science

Try to recall some of your earlier experiences with science as you rekindle some of your earlier childhood curiosity.

1. As a student, what were your experiences with science?

_____

_____

2. What was your experience with the natural world?

_____

_____

Teacher Activity: Write Your Science Autobiography

Think back as far as you can. Use these questions to write your science autobiography.

1. What do you recall about your first exposure to science?

_____

_____

2. Can you recall events from your K–2 classroom?

_____

_____

3. What are your earliest memories of science and your involvement in science, both in and out of school?

_____

_____

4. Are they good memories?

_____

As you share your science autobiographies with others, you will see that we have all had varying experiences with science. We have learned from these experiences and want to create opportunities for memorable experiences with science for our K–2 emerging scientists.

What does this tell you about your views of science and scientists? Janice Koch (2005) aptly coined the expression "we teach who we are" in discussing science autobiographies. If we have negative stereotypes and perceptions of science and scientists, then that is what we teach our children. It is extremely important for you to closely examine your view toward science, scientists, and teaching science, because your perceptions and viewpoint will influence how you engage your children in science. Your feelings also impact your expectations and perceptions of children's ability and capacity to do science and become scientists. It is helpful to consider the following points in your approach to teaching science:

- Will your teaching reflect science as a static body of knowledge consisting of one right answer that has to be memorized or as a constantly expanding dynamic search for answers to questions that arise from our interaction with the natural world and our quest to better understand the world in which we live?
- Will you provide the kinds of experiences that will enable the scientist in each child to emerge?
- Will you enable your children to develop the dispositions that will allow them to continue on their journey to becoming scientifically literate?

Teacher Activity: Your Science Story

Think about your experience with science as a child and write your personal "science story."

1. What did you like?

_____

_____

2. What did you hate?

_____

_____

3. How much of it can you remember?

_____

You want your children to have good memories of their science class. You want them to be able to recall some of the questions they had and the process they used for finding answers to those questions.

Science Education Then and Now

How has science education changed since the 1950s? Science education has changed dramatically since the launching of Sputnik by the Soviet Union in 1957. Today as we teach science to K–2 children:

- Student questions guide science activities.
- Children experience examples of concepts before their names are presented.
- Life, physical, and earth sciences are treated in a more balanced way.
- Reading, doing, and thinking about science are combined.
- Mathematics, social studies, and language arts are incorporated into science in a more comprehensive, multidisciplinary way.
- The process skills of science are used to design more meaningful conditions for learning.
- Science learning is recognized as an internalized long-term change in behavior.

To some of us, this is a completely new way of looking at science. It is not the way we were taught, and now, as we teach our emerging scientists, we need to undergo a paradigm shift in the way we view science teaching and learning.

Many of us who find science a difficult subject to teach fit under the broad category of "fear of venturing into the unknown." This hesitancy might also stem from a resistance to change in general. The more uncomfortable you are about doing something, the easier it is to procrastinate or avoid the task entirely. In addition, there may be personal phobias or biases to overcome, including fear of the vast amount of scientific knowledge that is now available. There is no denying that we are living in the midst of an explosion of knowledge that no other generation has ever experienced. We are now surrounded by nanotechnology, plastics, synthetics, numerous electronics devices, computers, lasers, iPods, and iPhones. It should come as no surprise that this explosion of knowledge, with its effects on technology, elicits fear in some and insecurity in others—and not just elementary teachers. But if you are willing, you can replace your feelings of fear and insecurity with new skills and

knowledge. Additionally, teaching hands-on inquiry science requires far more preparation of physical materials than teaching other subjects. However, the time spent in the preparation is well worth the interest, participation, and achievement that you can foster in your young children.

Teacher Activity: Final Self-Reflection

Examine this question: How does knowing who you are and who your students are make you a more effective teacher?

Take-Away Thought

Before you can be an effective teacher, you must know who you are.