2005

Becoming a More Effective Science Teacher

Omar Morales
THE FLORIDA STATE UNIVERSITY

COLLEGE OF EDUCATION

BECOMING A MORE EFFECTIVE SCIENCE TEACHER

By

OMAR MORALES

A Thesis submitted to the
Department of Middle & Secondary Education
in partial fulfillment of the
requirements for the degree of
Master of Science

Degree Awarded:
Summer Semester 2005
The members of the committee approve the Thesis of Omar Morales defended on March 26, 2005.

Alejandro Gallard  
Professor Directing Thesis

Nancy Davis  
Committee Member

Penny J. Gilmer  
Committee Member

The office of Graduate Studies has verified and approved the above named committee members.
ACKNOWLEDGEMENTS
I would like to acknowledge the three most important people in my life. First, thanks to my wife Stacy who strongly “encouraged” me to finish this thesis. Second and third, may my two children Isaac and Ariana one day reap the benefits of all my work.
# TABLE OF CONTENTS

ABSTRACT

The purpose of this study is to determine this teacher’s progress towards effectiveness in teaching. Three different perspectives are used to establish whether there has been a change towards teaching effectiveness. The first perspective will be my own by using autoethnography and analyzing it for my beliefs/perceptions of teaching modeled for me by teachers of my past as well as my beliefs now as I teach. The second perspective will be that of my eighth grade students’ ideas and beliefs about effective science teaching through surveys, questionnaires, and one-on-one interviews. The final perspective will be that of policymakers, especially those responsible for the National Board for Professional Teaching Skills and the National Science Education Standards. Included in this perspective will be those of educational researchers and the assertions that they make about effective teaching. From these three perspectives, the conclusion is found. Effective teaching consists of the qualities of: care, commitment, creativity, competence, and confidence. According to these qualities, I can then say that I am becoming more effective as a teacher.
CHAPTER 1
OVERVIEW OF STUDY
Introduction

The mediocre teacher tells. The good teacher explains. The superior teacher demonstrates. The great teacher inspires.
--William Arthur Ward

I wonder what Mr. Ward would say about effective teachers? Do effective teachers do all of those things: tell, explain, demonstrate, and inspire? Or do they have differing practices? What makes some teachers effective and some others not so effective? Are teachers “born” effective? Are there methods or practices that these teachers use on a consistent basis? Do they have certain character traits? Where do I, as a science teacher, fall on the spectrum? Am I effective or at least becoming more effective as a science teacher? This is the aim of this study.

There are so many varying ideas on what effective teaching is and is not. Most teachers, including myself, use the question, “Did my students learn?” as a determining factor. However, students come from a different perspective and ask questions such as, “Is the class fun and not boring?” or “Will I get along with the teacher?” Administrators judge effectiveness according to checklists and whether or not the teacher, when being observed, shows these characteristics or practices. “Does the teacher give sufficient ‘wait time’? Do they circulate around the room attending to the needs of the students? Are there objectives being used in the lesson plans?” To add to the mix, parents, politicians, legislators, and researchers have their own ideas and conceptions of what is effective teaching and what is not. So, the question still stands, “What is effective teaching? Am I becoming effective as a science teacher?
When this research began, I had many questions that I wanted to answer through this process. For example, written on the first page of my journal labeled “my questions,” it reads,

What effects does group work have on a students’ progress?

How can I improve engagement with the learning process?

What methods can be used to improve comprehension and understanding?

What role do “hands-on” labs have on comprehension and understanding?

I soon realized after reviewing someone else’s thesis that all these questions could be wrapped into one question. That question being, “Am I becoming effective?” Am I, as the teacher, ensuring that my students have an opportunity to learn? I observed little evidence of learning despite the use of laboratories and “hands-on” activities. I was concerned that I might be the cause of the problem and so decided to look at myself as the teacher through introspection and reflection and make necessary changes so that the students in my eighth grade science class benefit. I would have to become a reflective practitioner. Debra Daniels in her article explains,

What exactly is a reflective practitioner? To many, reflection means spitting back what they have read, but there is a distinct difference between retelling and reflection: A framework for reflection can provide the structure for looking back with the goal of moving forward. Reflection requires one to look back and consider many dimensions of an event, such as, influencing factors, identifying
controlling factors, and then deciding if any adjustments can be made for the next time. [p. 3]

I intend to look back over my years of teaching and learning with the goal of “moving forward” or, in other words, improving. I am doing this research in order to become a better science teacher. Reflection is just one method that will aid me in the process of becoming more effective. My journal will help me accomplish the task of looking back to move ahead.

... journal writing allows one to reflect, to dig deeper if you will, into the heart of the words, beliefs, and behaviors we describe in our journals. It allows one to reflect on the tapes and interview transcripts from our research endeavors. If participants also keep a journal, it offers a way to triangulate data and pursue interpretations in a dialogical manner. It is a type of member check of one’s own thinking done on paper. (Janesick, 1999)

Looking back is just one of many means of determining my effectiveness as a teacher. I will also take into consideration the perspectives of my science students. I did this through the use of interviews with individual students, surveys, and questionnaires. By these methods, I hope to understand what eighth grade students at Redland Middle School believe constitutes effective science teaching.

The final piece of this puzzle will be to analyze what different organizations consider effective. I will examine what the National Board for Professional Teaching Standards (NBPTS) considers effective teaching as well as the National Science Education Standards (NSES). Included in this analysis will be researchers’ conceptions and ideas of what effective science teaching is and is not.

By incorporating these three viewpoints, (my reflections/perceptions, students’ perceptions, and researchers’ perceptions/expectations) I hope to
find some common ground between all perspectives. In so doing, I will be able to identify effective teaching practices, ideologies, and methods and then be able to state whether I am becoming more effective as a science teacher.
What does constructivism have to do with effective teaching? In order to answer this question, one needs to understand this term. One needs more than understand, but actually realize that these are the “glasses” to look through to understand effective teaching. In other words, this philosophy of learning is the framework for effective teaching.

I had to revisit my past experiences as a student to begin to see this. Looking back over my time in school, both primary and secondary, there was always one thing in common. The teacher of that class would almost always be found in front of the class disseminating information. He or she would be the sole provider of information. The class would be quiet unless someone had a question. The teachers would quickly listen to the question, answer it, and return to what they were doing. I believed that teachers knew everything. If they knew everything, then I should listen to what they had to say so that I could know some things as well.

All the things spoken or written by the teacher were important and were expected to be known. I, as the student, noted all these things said by the teacher and later studied them so that I could pass the test consisting mainly of remembering words and ideas. I would pass most of these tests because memorization was always one of the skills I had learned to master early in my school career. I could regurgitate facts and formulas with no problem whatsoever.

However, if you were to ask me questions about that topic later during the week, I don’t believe that I would have been able to show that I had studied and learned that information. The learning that I believed I had
acquired was gone. Most likely, this is because I never really learned the material. I memorized facts and figures and formulas but never had an understanding of the concept. I would never have been able to apply my “acquired knowledge” to other situations. I definitely would not have been able to explain what I had supposedly learned to another person. All that studying, learning, and note taking was futile because I did not retain the information.

Unfortunately, my experience is shared by many students, even today, in science classrooms all across America. As I began my teaching career, I saw myself falling into those old patterns that were modeled for me while I was a pupil. Knowledge was something to be transferred from the educator into the empty minds of students. I would attempt to fill minds of students to the brim with all my wisdom and understanding. Students in my class were expected to listen quietly, take notes, and absorb all this knowledge I was giving them. At that time in my teaching, I was not interested in what they knew. What would they know anyway? I would change their thoughts and ideas soon enough by giving them all these new ideas that would replace the old ones. I quickly learned that learning, and even teaching does not work that way.

My understanding of teaching and learning began to change when I was introduced to the idea of constructivism. I was halfway through my first year of teaching when I decided to begin a science education masters program for elementary teachers. As I began my coursework, I heard this term “constructivism” more often. My professors and classes in graduate school revolved around this philosophy. I remember sitting not in rows but in groups of three or four people. We were encouraged to discuss, dialogue, and even argue about what we thought we understood and believed about
science education. It felt strange and uncomfortable as a student because the teacher did not act as if he or she knew everything. As a matter of fact, there were times when the professor answered a question with, “I’m not sure,” or “I don’t know.” “What do you mean you don’t know?!!! You’re the teacher! You’re supposed to know everything!” These thoughts raced through my head during the first week of physics for elementary teachers. This class was something unique in that it was designed for elementary majors/teachers with no college background in physics. I recall frustration, anxiety, and discomfort at the idea of the teacher “giving up the reins” in their own classroom. During those two months I watched my grades drop like a rock. I was angry that the teacher would not do his “job.” I was past the point of exasperation. Every assignment I spent hours working on came back to me with a failing grade. What was I doing wrong? When is this teacher going to “teach?” I did not like that all questions directed to this professor were redirected back at me in the same form; never an answer. I never really knew if I was right; that was not an enjoyable feeling. I realized that I used the teacher as I would an answer key for a test. He confirmed my “rightness.” Now, the problem was that he never confirmed whether I was right or wrong. I didn’t have answers. Questions asked continued receiving more questions. How infuriating!

Somewhere during the middle of the course, I learned to be satisfied with the process of learning. This new idea of learners being the focus finally felt comfortable. The only way to describe it would be like learning a new language. When I took French in high school, I understood nothing uttered from the teacher’s mouth. “Bonjour, comment t’allez vous” could have meant “My pants are on fire”. I didn’t understand the language. However, as my exposure and experience grew with the language, words, and even
sentences, started to have meaning. French made sense. In the same way, I was finally speaking “physics.” Unfortunately for my grades, sense-making takes time. However, once I could express myself properly my grades and my understanding of physics concepts improved dramatically. Physics finally made sense and was no longer painful. This physics course, more than any other course I had taken in college, fleshed out the idea of constructivism for me. I recognized that I could incorporate this learner-centered framework of teaching in my own teaching. I wanted to learn more.

Constructivism offers a new set of assumptions about learning. It presents the argument that a complete explanation of how learning occurs in the classroom must include a consideration of the experience of the learner, the key participant in learning. Constructivist teaching approaches focus on learners’ views and efforts to consider new ways of thinking about things, for it is the learner who must do the work of integrating ideas into his or her thinking. To help learners do so, we [teachers] must begin to explore the extent to which we involve them as active agents in their own learning. (Shapiro, 1994, p.9)

Basically stated, constructivism is a theory of knowledge that says that students learn by building (constructing) meaning through their own attempts to make sense of their experiences. This has huge implications especially for a teacher like me. The focus in the learning environment is on the wrong person according to the traditional method of teaching. Teaching should shift its attention to the learner because it is he or she that is making sense of what they are experiencing, hearing, or reading. The student is the one that comes into the science class with preconceived ideas of how things work even though their ideas may not fit with what has been interpreted by scientists. Creating an environment that spurs students to deal with these preconceived ideas against what they are finding out for themselves through the use of constructivistic teaching techniques is the goal of effective
teaching. Teachers should shift the focus on the learner and make them the active agent in the learning process.

Rather than being powerless and dependent on the institution, learners need to be empowered to think and learn for themselves. Thus, learning needs to be conceived of as something a learner does, not something that is done to a learner. (Fosnot, 1989, p.5)

There are college students, including Harvard graduates, who still believe that the reason for the seasons has to do with the varying distances of the Earth from the Sun. (A Private Universe, Pyramid Film & Video) Speaking for myself, I remember thinking that idea sounded good and it made sense. In my experience, the closer you got to a campfire the hotter it would get. This misconception about the Sun fit with what I knew. I never gave it a second thought.

I never truly understood what was causing the seasons because I was never asked to face the flaws with my theories. There was no discomfort with the discrepancies. My thoughts were a jumble of what I knew and what I had learned. Robertson in Constructivism and the Learning Cycle gives a perfect example of what I am discussing.

For example, suppose you want to teach your kids the concept of density. You figure there’s no way to discuss the concept without defining it first, so you go to the board and write:

\[
\text{density} = \frac{\text{mass}}{\text{volume}}
\]

And the kids are looking at this and thinking, “hmmmm ...... I went to Mass on Sunday...... my radio has a volume knob...... Density...... my brother calls me dense, so that means stupid...... okay, now...... stupid – church – radio. I don’t get it. Never did understand this science stuff.”
Because we tend to construct our knowledge, the students will try to make connections like this. In many cases, they make some strange connections. If the connections don’t make any sense, there is a tendency to just throw the whole thing out the window. There’s nothing wrong with this, it’s human nature. The problem comes in when students see most of their education as a piling on of things that don’t connect and don’t make much sense. That’s when you get kids memorizing everything rather than trying to understand it. Not a good thing. [1996]

In my science class, this happens day after day. Students do what I did and other people do. They learn something new and attach that learning to what they know of the world and the end result is a mix and match of science and make-believe. But now that I know what constructivism is and how it relates to teaching and learning, I can work towards those connections that students need to make sense of science ideas. Imagine what would have happened if a teacher had questioned me and given me opportunities to test my ideas against others’ ideas and set the stage for my learning by using inquiry-based labs. I attempt to do this for my students on a daily basis. I now recognize that the students are the focus of learning. My students come with ideas, some fit with what has been learned in science and other ideas are creative to say the least. The one factor that both ideas share is that they make sense to their owners. Constructivism gives me a framework from which to teach. I now understand that knowledge is constructed by the student. They use their prior knowledge and make it fit with what they are experiencing through hands-on labs and team discussions in my class.
Children’s science develops as children attempt to make sense of the world in which they live in terms of their experiences, their current knowledge, and their use of language. . .they make continual use of similarities and differences to organize the ideas they develop. Furthermore, in an informal and often non-explicit manner, children are continually gathering facts, developing explanations, and making predictions. (Osborne & Freyberg, 1985, p.55)

My role as a teacher changes from “fount of all knowledge” to that of a facilitator or coach. The students’ ideas take prominence. My understanding of their learning is my prime objective. So, I now ask questions to probe their understandings of scientific concepts. Students have to explain their meanings and understandings to me, to peers, and even to themselves through the use of journals regularly. The classroom environment’s sole aim is to encourage and foster the desire to answer questions. I alter the class environment so that inquiry and the process of learning are valued. The right answer is no longer the destination. How the students get there, the process, is more important. Problem-solving and critical thinking are instruments that I place in my students hands so that they can begin to answer their own questions. Constructivism allows me to teach so that the learners are the main players.

The role of the teacher is to organize information around conceptual clusters of problems, questions and discrepant situations in order to engage the student’s interest. Teachers assist the students in developing new insights and connecting them with their previous learning. Ideas are presented holistically as broad concepts and then broken down into parts. The activities are student centered and students are encouraged to ask their own questions, carry out their own experiments, make their own analogies and come to their own conclusions. (Hanley, 1994, p.1)
Using constructivism as a referent for my teaching, I now see myself as a builder of bridges. As a constructivist teacher, I attempt to make connections between students’ “alternative frameworks” (Watts, 1984) or “mixed conceptions” (Ault, 1984) and current scientific interpretations by providing opportunities to test their own ideas, answering them through the use of experimentation, and giving students experiences, through discrepant events, that don’t fit with their preconceived notions. By doing this, my desire is that students have a deeper understanding of why things work the way they do. I now teach for conceptual change.

In teaching for conceptual change, students must experience conflict with their expectations. It is only reasonable that students would not accept a new idea with first feeling that their existing views are unsatisfactory in some way. Posner, Strike, Hewson, & Gertzog (1982) suggest that if students are going to change their ideas:

1. They must become dissatisfied with their existing conditions.
2. The scientific conception must be intelligible.
3. The scientific conception must appear plausible.
4. The scientific conception must be useful in a variety of new situations.

Teaching for conceptual change then, demands a teaching strategy in which students are given time to: identify and articulate their preconceptions; investigate the soundness and utility of their own ideas and those of others, including scientists; and, reflect on and reconcile differences in those ideas. (Kyle Jr., Family, & Shymansky, 1989, p.3-4)

I can evaluate whether this acquisition of understanding has occurred by changing the way that I assess learning. Instead of lower-order questions that use only recall, I use higher-order, open-ended questions that require the student to explain their ways of thinking and knowing. I take the time to listen to the students. I make my students active in the learning process.
Constructivism suggests that teachers need to help students become active inquirers who, when they fail to find the meaning they seek, do not give up hope, but conclude that they have not looked in the right place. It is the teacher’s job to help students see that there are an infinite number of “right” places. Teachers need to coach students in the process of construction to help them become aware, deliberate, and responsible participants in the seeming chaos and disorder of the postmodern world and to help them develop a comfort with uncertainty in order to thrive in an environment where the only certainty is change. (Chrenka, 2001, p.694)

I listen to their meaning-making and question parts of their answer that may contain some “mixed conceptions.” I continue probing and finding the weak parts of their answers. I can do this on a one-on-one basis or in small groups. Evaluation and assessment change because of the epistemology of constructivism. Instead of “multiple-guess” tests, I administer short essay tests with higher-order questions that allow the students to convey their understanding of science through words and diagrams. The focus is no longer on vocabulary and the memorization of definitions. Now, attention can be placed on concepts and “big ideas.” For example, instead of assessing whether the definition is known, I can request that examples be given of that phenomena or connections made between one concept and another. By using constructivism as a referent for my teaching, I improve the learning environment. As a result, I have students learning deeply and making connections in a new way.

I observed this recently. I have a fish tank at home and at school. The tank at school is full of aggressive fish. The fish started picking on one of the weakest. I took him home and was expecting the fish to die. He looked bad. A couple of days later, I look in the tank and I see the
transplanted fish swimming around happily. It appears that he was in a better environment. The fish in the aquarium at home are community fish which means that they are not as aggressive. I started thinking about this and wondered what would happen if teachers “changed” the environment of learning so that it was more conducive to learning. Would the learners thrive the way I just observed this fish do?

Knowledge is actively constructed by the learner, not passively received from the environment. This reacts against other epistemologies promoting simplistic models of communication as simple transmission of meanings from one person to another. The prior knowledge of the learner is essential to be able to "actively" construct new knowledge. (Dougiamas, 1998, p.1)

Most teachers teaching from an objectivist epistemology would question this statement. What happens to the control? Do kids really know anything before they come to us as teachers? How does one teach if the learning is student-centered? These are just a few of the questions that may run through the minds of teachers who are familiar and comfortable with the objectivist point of view. Gone are the days where the teacher is the sole disseminator of knowledge and learners the “empty vessels” waiting to be filled.

Learners have ideas of how things work that make sense to them. Students have preconceptions, misconceptions, and creative conceptions to explain the way their world works. The job of a teacher is to bridge their previously acquired knowledge with accepted scientific interpretations and understandings of the day. This is done by providing opportunities to explore, inquire, and wonder about science. In other words, a teacher has to set the stage for discovery in learning.
Although the roles of the teacher will change by using constructivism as a framework for learning and teaching, this does not mean that the teacher is powerless. I would venture to say that this epistemology puts the teacher in the “driver’s seat.” He or she is in charge of ensuring that the environment in their classroom is conducive to learning. As Tobin (1990) suggests, “The constructivist classroom has the potential to provide an environment in which higher-level cognitive learning is enhanced in science. He continues by stating, “Although students have responsibility for what is learned, teachers have a direct influence on the context in which classroom learning occurs.”[p. 34] Teachers are gardeners ensuring that the flowers in their care will bloom because time and energy was taken to provide an adequate environment. Sun, water, soil, and time are all the necessary ingredients to get a flower to bloom. Effective teachers, using constructivism as a referent, employ a variety of teaching techniques that encourage meaning-making. Teachers that are effective use all these techniques so that their students bloom: inquiry-based laboratories, an opportunity to problem-solve, critical thinking, time to discuss their interpretations with each other, and time to explain their thinking to themselves and the teacher.

**Policy Literature**

The recommendations and suggestions of organizations committed to the reform of science teaching are numerous and prolific. One of these organizations is known as the National Board. This organization certifies teachers who have undergone a rigorous and lengthy process. This particular organization has its own ideas on what skills effective teachers have and use on a daily basis.
According to the National Board for Professional Teaching Skills (NBPTS), teachers should know and follow these five core propositions:

1) Teachers are committed to students and their learning.
2) Teachers know the subject they teach and how to teach those subjects to students.
3) Teachers are responsible for managing and monitoring student learning.
4) Teachers think systematically about their practice and learn from experience.
5) Teachers are members of learning communities.

Similar statements by other organizations echo these five core propositions. The National Science Standards (NRC, 1996) echo this proposition in Standard D of their policy statement, “What Teachers Should Know and Be Able To Do”,

Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science. In doing this, teachers

- Structure the time available so that students are able to engage in extended investigations.
- Create a setting for student work that is flexible and supportive of science inquiry.
- Ensure a safe working environment.
- Make the available science tools, materials, media, and technological resources accessible to students.
- Identify and use resources outside the school.
CHAPTER 3
METHODS & PROCEDURES

The attempt of this study is to put into words what teaching looks like, sounds like, and even feels like. That is difficult to do within the context of quantitative research. Numbers and charts will not adequately portray my experience as a science teacher of eighth graders at Redland Middle School. How do I convey the feeling of triumph and joy when one of my students finally “gets it”? A graph can’t appropriately convey my frustration when students fail yet another test despite the fact that we have been doing “hands-on” laboratories the entire school year. A different method is necessary.

Qualitative research offers a unique approach to share my experience as a teacher and the experience of my students. Within this context, there are a number of methods to inquire into the questions that I have posed. Any and all of these methods allow me to convey feelings, beliefs, perceptions, and thoughts adequately.

Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible. These practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations, photographs, recordings, and memos to the self. At this level, qualitative research involves an interpretive, naturalistic approach to the world. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them. (Denzin & Lincoln, 2003, p. 4)

Through the use of qualitative research, I can examine particular instances that show what I believe is effective teaching. I can share my memories of effective teachers from my past. It permits me to share reflections of times that I felt effective as a science teacher and times when I
did not. This type of research gives me a voice with which to speak about teaching in a natural way. It also gives my eighth graders a voice to speak about their beliefs and perceptions about effective science teaching. I believe that the use of qualitative research is the most valuable way to tell my story, and at the same time, make sense of my story.

Qualitative inquiry—in this case the study of schools or classrooms—can provide the double advantage of learning about schools and classrooms in ways that are useful for understanding other schools and classrooms and learning about individual classrooms and particular teachers in ways that are useful to them. (Eisner, 1991, p. 12)

Autoethnography

One of the methods employed in this study was the use of autoethnography. What is it? How is it done? Deborah Reed Danahay (1997, p. 2) explains,

Autoethnography combines autobiography, the story of one’s own life, with ethnography, the study of a particular social group.”

Denzin [p.6] argues that the “important characteristic of autoethnography. . .is that the writer does not adopt the ‘objective outsider’ convention of writing common to traditional ethnography. [It] entails the incorporation of elements of one’s own life experience when writing about others through biography or ethnography. (as cited in Danahay, 1997, p.2)

So, through this study I will tell the story of my own educational life and then analyze those stories within the context of my classroom. This will give the reader an idea as to what formed my perceptions of effective teaching.
inquiry into personal experience is simultaneously focused in four directions: Inward, in the sense of feelings, hopes, aesthetic reactions, moral dispositions and so on (internal conditions); Outward, in the sense of paying attention to the wider environment, the world of social roles and relationship and the kinds of lives people live (existential conditions); and Backwards and forwards, referring to the temporality of experience which acknowledges the sense of history and the intentionality of the organism undergoing the experience. For researchers there will be an autobiographical quality to their experiences. The stories heard and the texts read will invoke the researchers’ own experiential memories with their own temporality, which in turn will influence the meaning made of the events referred to in the texts and stories. The same is true of readers of research texts. (Quinlan, 1996, p. 1)

I can tell my story as a student and learner and then turn around analyze those stories, memories, and reflections. I can make sense of those experiences, thoughts and feelings in a way that I cannot with a quantitative method. This qualitative method gives me a better opportunity to share my findings so that the readers can make sense of my experiences and stories. They, then, from my analysis and their own, can interpret what they believe effective teachers to be.

Narrative Inquiry

Another method that is used within this study is the use of narrative inquiry. Connelly and Clandinin (1990, p.2) explain that, “Humans are storytelling organisms who, individually and collectively, lead storied lives. Thus, the study of narrative is the study of the ways humans experience the world.”

Through the use of my stories within my classroom, I begin to understand how I experience my world. “. . .narrative is both phenomenon and method. Narrative names the structured quality of experience to be studied and it names the patterns of inquiry for study . . . people by nature live storied lives.
and tell stories of those lives, and narrative researchers describe such lives, collect and tell stories of them, and write narratives of experience.” (as cited in Quinlan, 1996, p.1)

In room A213 at Redland Middle School, there are stories and experiences occurring on a daily basis that I and my students share. I will retell some of those stories through the use of narrative. These can be considered “snapshots” of what happens in my science classroom. My conversations with myself and with my students are those collected stories. In those stories there is much to be learned. The interaction that I have with my students will show my beliefs as well as the students’ own beliefs. The interpretations of these “snapshots” will aid me in understanding whether I am becoming more effective as a science teacher.

. . . interpretive or narrative inquiry assists in understanding how certain audiences (administrators or teachers, for example) make sense of their settings, thereby enabling us to gain deeper insight into how such things as moral imperatives, empirical evidence, and personal biography affect plans, intentions, and practices. [Another] value of such research is that it is often more accessible to those deeply engaged in practice and thus serves as a means for gaining perspective on the uniqueness of situated space and time. . .INR[Interpretive and narrative research]permits both reflection and growth. (Fenstermacher, 2002, p. 244)

By telling my teacher story, I begin to grow and see how I have and changed over time. My story is important because from it I make meaning of what I do as a teacher. From that meaning-making, I learn more and so do others interested in the practice of teaching. In telling my story, as Jalongo & Isenberg describe perfectly, there are some qualities that need to be present.
Teacher narratives are ways of expressing the values that undergird authentic teaching. Teacher stories are much more than charming anecdotes. They relate experiences that evoke stories from others, encapsulate professional perspectives and promote insights into the meaning of teaching. A good and useful teacher narrative has at least four characteristics that contribute to education:

* A teacher narrative should be genuine. A real teacher story resonates within every educator. An authentic teacher story is not contrived to be cute, edited to flatter the teacher or sensationalized to overdramatize events. The story must "ring true" in order to strike a responsive chord.

* A teacher narrative should invite reflection and discourse. A good teacher story leaves us fairly bursting to respond--with comments about the story, insights into the underlying issues, stories of our own, even strenuous opposition. Authentic narratives stimulate dialogue and foster more reflective teaching practice.

* A good teacher story is recursive and reinterpreted. True narratives go beyond the "kids say the darndest things" mentality, looking beneath the surface, again and again, to discover the underlying meanings. The experience does not change, but the concepts and themes used to interpret the experience change as we amass other experiences, gain insight and become more thoughtful about what we do and why we choose specific courses of action.

* A teacher story is the antidote to a "technological mentality." Contemporary society puts its faith in methods, systems and new technologies. Teacher narratives urge us to look deeper, examining not merely how we deliver education, but also what we deliver. We must examine the issue of appropriate content and address the ethical concern of whose interests are served and promoted by our decisions. [p. 261]

I believe that my teacher story incorporates all these points. This thesis encapsulates my intention of making meaning of my teaching. It stimulates dialogue, encourages reflection, and gives insight into my effectiveness as a science teacher.
The use of case study was also used as a method within this study. More specifically, the use of intrinsic case study was used. I, as an active participant, was interested in the particulars of the happenings in my science classroom. Robert Stake (2003), in Strategies of Qualitative Inquiry explains,

I call a study an *intrinsic case study* if it is undertaken because, first and last, the researcher wants better understanding of this particular case. Here, it is not undertaken primarily because the case represents other cases or because it illustrates a particular trait or problem, but because, in all its particularity *and* ordinariness, this case itself is of interest. The researcher at least temporarily subordinates other curiosities so that the stories of those “living the case” will be teased out. The purpose is not to come to understand some abstract construct or generic phenomenon. . .The purpose is not theory building—although at other times the researcher may do just that. Study is undertaken because of an intrinsic interest in, for example, this particular child, clinic, conference, or curriculum. (p. 136)

I am interested in the occurrences within my classroom. I, as the researcher, want to better understand my actions, thoughts, beliefs, and feelings about science teaching. The classroom is where all the “action” takes place. Discussions, conversations, and actions happen in that room regularly. Those occurrences, I believe, will reveal my beliefs about science teaching. Analysis of those actions and beliefs will confirm a move towards science teaching effectiveness. Now, my interpretations, as the researcher, may not be the reader’s interpretations. This happens because knowledge is constructed using prior knowledge. The reader may associate the findings of this study some other study and make their own interpretations.

In private and personal ways, ideas are structured, highlighted, subordinated, connected, embedded in contexts, embedded with
illustration, laced with favor and doubt. However, moved to share ideas; however, clever and elaborated their writings, case researchers, like others, pass along to readers some of their personal meanings of events and relationship-and fail to pass along others. They know that the reader, too, will add and subtract, invent and shape-reconstructing the knowledge in ways that leave it differently connected and more likely to be personally useful. (Stake, 2003, p. 146)

**Action Research**

Action research is just that: action and research. This method was used in addition to the previous ones mentioned above in this study. Action research is a unique and practical method that teachers employ to inquire into the happenings of their classrooms. The teacher-researcher may focus in on the usefulness of a particular classroom management technique. The overall goal of action research is improvement in teacher practice. Generally, this is more of a collaborative inquiry than it is individual. However, the objective remains the same.

Action research is deliberate, solution-oriented investigation that is group or personally owned and conducted. It is characterized by spiraling cycles of problem identification, systematic data collection, reflection, analysis, data-driven action taken, and, finally, problem redefinition. The linking of the terms “action” and “research” highlights the essential features of this method: trying out ideas in practice as a means of increasing knowledge about and/or improving curriculum, teaching, and learning. (Johnson, 1993, p.1)

This method gives me the opportunity to inquire into my own science teaching. I have done this through the writing of this paper. As an example, I noted that my students would continuously fail tests even though inquiry based-laboratories were being used on a regular basis. I reflected over this dilemma. I realized that what I was teaching was not being tested. So, after observing this problem, I decided to change the way I evaluated my
students. I now use a test that has a better connection between what they learn in class through investigations and the questions that ask them to explain scientific ideas in their own words. The results are still not final on how my students this year are achieving with this new testing method.

The results of action research are very important to my teaching individually. It gives me a better understanding of my classroom and my students. I have a better perspective on what is working and what is not yet working within the confines of that classroom.

Teacher-researchers are first and foremost teachers ... The insider role of teacher researcher brings with it a unique combination: the power associated with first-person insight, the limitation of participant perspective, and perhaps a bit of tension involved with trying to simultaneously teach and study one's teaching environment.... teachers are in the best position to explore their own practice and make sense of the classroom worlds ... (p. 18). (as cited in Eckert, 2004, p.244)

Through this process of action research I, as a teacher, become more reflective about what I do on a daily basis. I find that I think about what I am doing in my class and I ask myself why I am doing it. No longer do I practice my professional skills without giving whatever it is that I am doing some serious thought.

Data and Collection

I collected and analyzed many forms of data during the course of this study. I used my personal memories to write the section titled “Looking Back” which consists of my experiences as a student from elementary school through graduate school. I recorded my personal reflections, thoughts, and feelings into my journal and audiotape recorder. I used these sources as an autobiographical account of my teaching in elementary and later in middle school. I surveyed students by asking them to evaluate certain statements
related to science and science teaching. Another form of data was the questionnaire. It asked open-ended questions pertaining to science and my science teaching. I interviewed three students in my science class. The information taken from the interview was used as data for this study as well. The final piece of data used was student to student conversations and student to teacher conversations. All of this information will aid me in answering the question, am I becoming a more effective science teacher?
CHAPTER 4
LOOKING BACK- A STUDENT’S PERSPECTIVE

What makes teachers effective? Were my teachers over the years effective? Why do some stand out so clearly while others just fade into the recesses of my mind? What qualities did the ones that I recall have that the others did not? Did they model effectiveness so that now I recognize effectiveness in myself? These are just a few of the questions that I attempt to address as I reflect on my schooling. I begin with my earliest memories in elementary school. Surprisingly, I can remember a number of my teachers because most had an impact on me and my learning. I continue with middle and high school experiences. After that, I analyze and discuss university professors and classes. In this section, I include my student teaching at Chaires Elementary School. I finish with my graduate classes and focus specifically on my time in the class that had the most profound influence on who I have chosen to be in terms of a teacher/learner.

Elementary School

When I was young, I remember being at a number of elementary schools from first grade to sixth grade. There are many teachers who invested time and energy into my learning. I would say that school came easy. I enjoyed reading, learning, and studying. I took to school as a fish to water. So, I would guess that teaching was easy for my teachers because I was eager to learn. Although quiet and shy, I was curious and inquisitive. I responded well to teachers that showed that they cared about me and my learning. North Twin Lakes was my first school in Miami and Mrs. Rolle was my first teacher. She taught me in both first and second grade. She was one of those teachers that showed that her students were important. As is the case with most primary teachers, she was sweet and caring. She was also very
encouraging. Mrs. Rolle had high expectations as well. An example of this was when she exposed her second grade class to multiplication. At first, it made no sense. However, a friend invited me to his home, and I found that other students didn’t “get it” either. Together, we all figured it out. In retrospect, I may not have been at the appropriate conceptual level to be able to make sense of it. However, it reflected her beliefs about her students’ abilities. She had high hopes and we lived up to them.

Mrs. Clemente was my third grade teacher. She also had high expectations for her students. She taught us about Florida history and assigned us an interesting project. We were required to make a diorama having to do with Florida. I chose Cape Canaveral because, at the time, astronomy and space were of high interest to me. I remember spending hours on this project. I went in search of all the materials I believed I needed to succeed. I used toilet paper rolls, empty medicine containers, and little Lego men. My work, as I expected, received a high grade. She also rewarded my efforts with a simple certificate that I still own today. I treasured that form of written praise. Her verbal praise also held great importance to me. I gave her a necklace for Christmas. I doubt very much that it was worth any more than five dollars. The point is that this teacher had my respect and admiration as a student. I never gave any of my other teachers gifts which speaks well of her as a teacher.

My family moved during the summer. A different school with unfamiliar classmates and an unknown teacher were waiting. I was placed in Mrs. Neal’s fifth grade class at Twin Lakes Elementary. Mrs. Neal was a creative teacher who loved working with kids. The one clear memory I have of Mrs. Neal is that of a musical show that she produced. Students auditioned for dancing, singing, reading poetry, and even “breakdancing.” Neal gave every
student an opportunity to shine. Fortunately, my talent was none of those previously mentioned. She decided to let me shine by being one of the two emcees. My responsibility was to introduce each act and give some background, all of it memorized. Maybe she made me an emcee because I could not sing or dance. Who knows? The message sent to me was that I was smart and dependable. This teacher believed that I was more than ordinary. I took it to heart. She believed it by placing her confidence in me so I believed it. This message was reinforced later in the year.

I participated in a school-wide spelling bee. Cheers filled the cafeteria as I successfully knocked off one word after another. The room was covered with elementary students staring up at the last two contestants, one a fifth grader and the other a sixth grader. “Lieutenant,” called the announcer. My mind went blank. Every word before this moment crystallized in my brain. It was like having a photographic memory. I could “see” the words in my head. Now, nothing; no words formed themselves in my brain. So, I figured I could sound it out. I knew what the word meant but I wasn’t familiar with French words. So, I began “lieutenant, l-e-i-u-t-e-n-a-n-t, lieutenant.” I closed my eyes. “Sorry, that is incorrect,” stated the announcer. I spelled it wrong. I was crushed. Tears rolled down my face. It felt as if the world had ended. I slowly climbed down the stairs with my head down and made my way to the back of the cafeteria. Embarrassment and shame at letting my class and teacher down enveloped me. I could not face any of them.

What I did not realize at that moment was how proud my class and my teacher were of me. Hugs, handshakes, and words of encouragement lifted me from my dreary mindset. They were proud of me. If I hadn’t known better, I would have said that I had won by the reaction of my classmates and my teacher. To this day, I remember the word that made me take second
place in the spelling bee; lie-u-ten-ant which is how I now spell it. Mrs.
Neal showed me the support that I needed at the right time. She reinforced
that I was unique and more than ordinary. I took that message with me to the
next level.

Moving on to sixth grade was a big and exciting change because I was
one step closer to junior high school. As a method to ease the soon to come
transitions from elementary to junior high, sixth graders would switch
classes according to the subject. So, that year I had more than one teacher.
Mrs. Murphy was my mathematics teacher, Mrs. Clinton was my reading
teacher, and Mr. Ramlow had all the other subjects. Mr. Ramlow stands out
in my mind because he was as tall as a palm tree. I had to strain my neck to
speak to him. He walked slowly and methodically. As a matter of fact,
everything he did was deliberate. I remember listening intently to him as he
read one of my now favorite children’s books called James and the Giant
Peach.

Mrs. Murphy taught the advanced mathematics class. She was
businesslike. Everything that was done had to be done quickly and
efficiently. The worst memory I have of her class was of me standing in
front of the chalkboard with numbers just staring back at me. I was called
up to the front to show how to solve a subtraction problem. I wasn’t the
only one; there were others as well. It didn’t feel like it though. I felt as if I
were up there all alone. I may have been standing up there in my underwear.
That is how vulnerable I was feeling. I felt this way because I could not
remember how the teacher had taught us to solve this particular problem. It
was no simple subtraction problem either; not 9-5. It was a 3 digit problem
with regrouping. I had not figured out how to solve it. I could almost hear
the numbers laughing at me. I knew there were numbers to cross out
because that is how Mrs. Murphy solved it each time. Cross out one number, put a mystery number on top, (where did that number come from?), cross out another number, another mystery number, and, voila, there was the answer. I didn’t understand. I didn’t know the mysterious code that Murphy used. There was no hope. I was not going to solve this problem.

The next time I went to mathematics I found myself sitting in Mr. Ramlow’s regular mathematics class; not Murphy’s. I learned how to play the game of school. I learned that I should always look for the “path of least resistance”. “Never again,” I vowed. “Never again will mathematics make me feel that exposed and that dumb,” I swore to myself. My solution to mathematics was to settle for mediocrity. This would show later on in middle and high school. From that point on, mathematics was no longer my favorite subject. In my mind, Mrs. Murphy missed a golden opportunity. I probably would not have avoided difficult classes that made me think, really stretch myself mentally, had she helped me make sense of subtraction with regrouping. She lost me as a mathematics student forever.

Junior High

I remember a certain number of teachers from junior high school but the one that stands out clearly is Mr. MacDonald. He told us to call him “Mr. Mac.” I did and so did everyone else. He taught eighth grade English. Mr. Mac loved teaching and all of us knew it. He did things differently and encouraged us to try and do things differently too. He had excellent rapport with his students and shared personal anecdotes about his various trips to Europe, especially Germany. This was extremely relevant when we began studying Anne Frank’s diary. We discussed the book and how it made us feel. I listened as Mr. Mac recounted his personal experiences of his visit to a concentration camp known as Auschwitz. It was better than a movie. He
made it seem as if we, as his class, were there. After the book, we watched a documentary of Anne Frank’s life. I wanted to learn more. Mr. Mac set the stage by arranging for us to visit a special exhibit in downtown Miami dedicated to the Holocaust and its survivors. I actually spoke to someone who survived that horrendous time in history. I recall the sense of wonder listening to this person recount their experiences. Had we just read the book and never discussed it, I do not believe that the field trip would have been as meaningful. My English teacher had set the stage so that I could do more than learn about that time period. I experienced it.

I remember just enjoying his class because of how unorthodox it was compared to the regimented rows in other classes. We talked, discussed, learned to write creatively. Mr. Mac’s enthusiasm for learning was contagious. His students would share their insights and thoughts through language both written and spoken because they were infected with the joy of learning. Writing creatively was one of the many activities that Mr. Mac put into our day. He had us write for a purpose, for each other, not just for him. I remember listening to creative and inventive stories full of life, given to them by high school authors. Mr. Mac participated, just as we did, by listening and enjoying. This was a new experience. We were given a safe place to share our thoughts, feelings, ideas, and dreams. I appreciated the fact that others had worthwhile and unique ideas to share in class, which made the class better. Mr. Mac knew this and watched as we made the class ours instead of his. He was an effective teacher. His belief in the abilities of his students is what made him exceptional. An environment conducive to learning was created so that students of all sorts could thrive. We bloomed as writers and thinkers in that class, all thanks to Mr. Mac and what he understood about teaching and learning.
In the middle of my ninth grade year, my family moved again. Once again I would have to deal with another unfamiliar school and all that it would entail. There was a little surprise however. I would still be going to the same building, just at a different time. I would be attending class from noon until 5pm. I now understood why there was a split schedule at this particular school. I was at the same place, but I was not a part of the same school. I was now a part of Jose Marti Junior High School.

One of the classes in my new schedule was a power mechanics class taught by Mr. Berman. He was the classic shop teacher. He was a heavy set, balding man, who was gruff and stern. I did not know what I was about to experience when I walked through the door as a new student in his class. I must admit that I was excited about the proposition of being a part of a mechanics class. My dad’s pride was a motivating factor. I wanted to impress him with what I had learned. When my father worked on the car, I could now help.

As I walked in, I noticed that this was a small class of all boys. There were two rows of tables with two or three boys at each. I learned more and more about engines and how they worked as the school year progressed. The activities, “hands-on” is the term used today, gave me the practice that I needed to understand and comprehend this new language of power mechanics. I learned to disassemble a one stroke engine (the kind of engines found on lawnmowers) and how to reassemble it back again. Berman would walk around from group to group offering suggestions or just observing. I learned how to make an electrical outlet tester which actually worked! One demonstration, which I am sure no teacher could get away with today, involved using a spark plug that was still connected to the engine. Mr. Berman was explaining how spark plugs worked and how to gap them
correctly. One of the kids asked a question. In response, Berman explained what he had planned. It involved the class standing up and holding hands. One of the students was to hold the spark plug. He gave me and others who weren’t so brave the opportunity to opt out of this demonstration. I accepted and observed. What I saw was pretty amazing. Mr. Berman reached down and grabbed the cord that starts the engine and yanked hard. Not a even a second later, all the boys in the human chain yelped as the electricity coursed right through them. We all laughed and started discussing how electricity works and what it all had to do with the engine. Not the safest way to engage interest in a topic but it was pretty effective. I still know how to put together a lawnmower engine.

High School

High school was a painful time in my life. All my friends were doing the moving this time. They were headed to a high school where I would not be headed because of my address. I was depressed and school dropped to bottom of my list of priorities. During tenth and eleventh grade, I went into survival mode. I did just enough to pass my classes. An example of this would be Algebra II. My teacher was doing all that she could do to get me to succeed in her class. This new language of mathematics made no sense and so I “turned my brain off.” I went to daydreaming and doodling and sometimes even napping. Needless to say, I failed that class miserably. I do not blame the teacher whatsoever. She did her job, I did not do mine.

Because of that failure, I had to attend summer school which meant that I would not be going to summer camp. I regretted the choice of “blowing off” mathematics. During summer school, the teacher did his job well. I did my job well too. I passed with a satisfactory grade.
At the beginning of my senior year, I decided to take whatever class I thought would be fun and interesting. That turned out to be one of the best decisions I have ever made. I went to my advisor to let her know what I wanted to do with my senior year. She was so impressed with my decision to take all academic classes including four sciences (AP Biology, Honors Physics, Chemistry II, and Anatomy and Physiology) that she had to show her colleagues. Slightly embarrassed, I took the card listing the classes that would make up my last year in high school.

As I stated before, high school was painful. Besides the fact that I did not have many friends come to American Senior High with me, my world was being turned upside-down when I found out my father was dying of lung cancer. Learning had become my safe place, so I buried myself in books and learning. I just kept myself busy. I began working at a nearby fast-food restaurant. My days were crazy but I now enjoyed my classes. The courses were fun and interesting to me. There were many inquiry-based labs that were open-ended. My job was to learn, to understand, to make sense out of all these different sciences. Out of those four science classes, Physics and Anatomy and Physiology were my favorites.

I remember staring at a billiard ball sized eye and it staring back at me with a cloudy blue iris. I removed the cornea, the sclera, the vitreous jelly and described and diagrammed them in my notebook. I could ask any question that I desired about what I was doing. My teacher, whose name I don’t recall, was helpful. But, most of the time, he would permit me to just explore and learn, which I loved.

Physics was a favorite because that teacher, Mr. Adams, was very knowledgeable about his subject. He gave examples of how the science related to our everyday world. A popular show back when I was a senior
was The Flash which was based on a comic book. The premise was that of a man who had the ability to run faster than sound. The class brought up this show during our discussions on sound. Adams gave us his thoughts stating that it was impossible because of the sonic boom that this person would cause. Seems silly, but he connected what I knew (that TV show) with what I was learning in class. Learning could be fun and relevant to me. I was seeing that more and more as I moved on from high school to the university setting.

I believe that choosing to take so many sciences was one of the best decisions I have made. The reason, in my mind, is that it helped me to get into college. I had failed a mathematics class even though I retook the class. I am sure that did not look good on my transcripts. However, my willingness to “go against the grain” and take difficult courses while my peers were suffering from “senioritis” helped to continue my learning career. I was headed to Florida State University.

College

My university experience, unlike high school, was an extremely enjoyable experience. I loved everything about college. It was a new place with new people. I was ready for a change. I came with the right mindset. I was going to learn and have fun. I took various liberal arts courses throughout my first and second year in college. Most of these classes consisted of one professor and hundreds of students. The professor spoke and everyone took notes. There was no time for extra help; it was “sink or swim.” Biology 101 was the extreme example. There was a booklet chock full of information. That was the textbook, nothing more, nothing less. Sitting in this class, you would have thought you were at a concert or some
sports event. That is how many people were in this auditorium; not classroom.

Over my first two years of college, I witnessed some professors who could teach and teach well. Others, in my opinion, had no business teaching. The only mathematics course I took during my college career was Pre-Calculus; it was mandatory. I was dreading this mathematical experience. A slender, black haired man was standing up front as I walked into the classroom. More and more students filed in and sat where they would be most comfortable. As the class began, the teacher introduced himself. I was surprised to hear the thickest accent I had ever heard. It could have been Chinese, maybe. I barely understood what he was saying. I was sure that he was speaking English, but it was so difficult to understand. I can only guess at the gentlemen’s ethnicity. He was of Asian descent, I was certain of that. I realized very quickly that his accent was going to cause me great hardship as the class progressed. It did.

I soon realized not a week into class that this was going to be one of the hardest classes I would ever take. I did not understand the man when he spoke. I did not understand the symbols and numbers he manipulated as he worked in front of the class. I was sinking and sinking fast. There was, in my mind, nothing I could do to “keep my head above water.” Staying up for hours on end studying did not make a bit of difference. Matrices and equations with variables to solve made no sense. Failure and disappointment were fast becoming my companions. I was frustrated and angry.

This professor was the “deliverer of mathematical information.” He stood in front of a board full of unintelligible markings. I am sure that in his mind he had done his job. The information was on the board for all to see. What else was there to do? The problem was that I did not see. I could not
see. I did not have his “glasses.” Questions seemed to be an annoyance to this professor. In answer to the question, he would turn his back to the class and start writing and talking while facing the board. It was so frustrating because I could not make “heads nor tails” of this class. The failure continued. I made an appointment to meet with this professor. Tutoring was my only option. Without it, I knew that I would fail. I had put forth so much effort to make some sense out of it all. I needed more time, more practice. There was no more time. Finals had arrived. I took the final exam and prayed to the Almighty that I would do well. I guess I was not heard. I failed with a D. I would have to retake the class, which is what I did.

The second time around I had a better time of it. I had an English speaking person with no accent. I understood. When my mathematics professor spoke, she made sense. She would work out problems on the board, but would often stop to make sure the class was following her and comprehending what she meant. Time for practice was given so that failure was not the norm. This mathematics teacher took the time to make sure that there was understanding. The concepts were still difficult to understand, but now my questions were being answered. Now all those markings on the board were understandable. Satisfactory marks and comments were over each assignment. The feedback was encouraging and I kept working even though it was difficult. Another positive aspect of my second mathematics teacher was that she seemed comfortable with us and with herself. I believe it made all the difference. She joked when it was appropriate. Good rapport was established showing that this teacher considered us human beings and not just students. When this class finally ended, a B took the place of my miserable D. I had actually learned mathematics.
I continued with my college coursework. I applied for the elementary education program and was accepted. The program was very selective. I would no longer be lost in the sea of humanity such as my Biology 101 class. As a matter of fact, all my classes were no bigger than 20 people. I was no longer surrounded by a multitude of strangers. These people would slowly become my friends and coworkers. Most of the work done for these classes consisted of group work. Learning to teach meant that my peers would pretend to be my students. Constructive criticism was a necessary part of the process. Reading, math, music, art, science, and physical education were just some of the classes to take. Friends of mine, non-elementary majors, joked and teased me about my assignments because they seemed so childish and, well, elementary. I guess they were to a certain point. How could I argue when I had to make a children’s book out of construction paper? Some assignments, compared to my friends, were easy. However, not all my coursework was that simple. A difficult yet exciting task was to teach fifth graders an art lesson.

The teacher had a small classroom consisting of about 25 students. The class environment buzzed with working students. I would soon be given the “reins” for a one time art lesson. My excitement surged. I knew I had a great lesson that would capture their imaginations. Michelangelo and his art were the focus of the lesson. I discovered a videodisc that gave breathtaking views of the Sistine Chapel. I pointed out certain elements of the work. “This is going well,” I thought to myself. “Wait until they see what is coming up next.” I continued with the lesson and gave some background on Michelangelo. I told the students that they were going to be like Michelangelo and paint on their backs. Their Sistine Chapel would be the underside of their desks. Paper, tape, and paint were distributed. Questions
were answered. They began their paintings. Some kids couldn’t come up with an idea. I walked to them and asked, “What are some of your favorite things to do?” They answered and the artwork came to life. Pictures of dogs, cats, the sky, and twenty other subjects were created by these artists. After the set time, the materials were collected. A line of students grinning widely proudly displayed their artwork. Everyone was impressed, no one more than me. The entire lesson took no more than forty-five minutes and I had survived. It felt good to be a teacher.

The closer I neared to my undergraduate experience, the more time I would be given to be in elementary schools. I observed, listened, questioned, recorded, noted, and learned how to teach from teachers. One subject, then two, then three were handed over to me as I came closer to being a college graduate (the first in my family) and an elementary school teacher. Mrs. Brown was a first grade teacher at Killearn Elementary. Eighteen little faces looked at me and waited for me to teach them. I wish I could say that every lesson went well. But, isn’t failing a part of learning? It was for me. “You went too long on that lesson,” said Mrs. Brown. “There are times to change the direction that you are headed when you see that they are not with you,” she continued. “You have to be sensitive to that.” The mathematics lesson had not gone well. The kids seemed lost and for some reason I was still nervous. Brown did not help to put me at ease. I felt that she was too hard on me. I am sure she would disagree.

During college, in order to pay the bills, I decided to work as a teacher’s aide during the after-school program at Chaires Elementary. This would be good experience since I intended to work with children for the rest of my life. I played, talked, listened, and enjoyed these little ones ranging in age from six to about ten or eleven. It was an easy job but the only drawback
was its distance from the university; about twenty minutes. When the time came to choose a school, I chose Chaieres Elementary. I could intern and then go straight to work. It was a good plan. My instructors made every attempt to dissuade me from my choice. My mind was made up.

Student Teaching
I was placed into a fourth grade classroom consisting of 27 students. The room displayed the work of the children. I could surmise that they had started learning about weather. There was a weather map on the wall. One of the students stood in front of the map and explained the weather for the day. The kids were rambunctious and full of energy. I could tell it was going to be an interesting semester.

Mrs. Clayton, after the weather report, introduced me to the class. She stood on the outside edge of the desks. There were two big groups of desks side by side running right down the middle of the room. It was a setup I had never seen. I wasn’t quite sure what was expected so I was feeling a little tentative. I sat and I observed. That did not last long. I was put to work quickly. As she was teaching, I made various kinds of clouds out of paper that would soon be hanging from the ceiling. Not exactly what I had expected.

As the days changed into weeks, I took a subject at a time. Mathematics was one of the first. She left the room while I taught during this particular lesson. The students had workbooks and me to help them understand mathematics. In this case, perimeter and area were the topics. I distributed rulers and a great idea came to mind. What if they do the measuring of whatever it is they want to measure? I trusted my instincts and gave the instructions. “Grab a partner and measure five things in the room.” The looks on their faces when they realized I was serious were priceless. Some
students measured each other. Others measured their desks. As the lesson progressed, one student had the idea of measuring the walls; all of them. I told him to go ahead and do it. He grabbed his partner and ran over to one of the walls and started measuring. I could tell they were having fun by all the smiles. I gave them another ten minutes and then the measuring ended. I asked them to take a look at their measurements. I gave them time to share their findings. The question came, “What do you think the perimeter is?” They looked at me and then they looked in their workbooks. I called on the one still working on the walls. Maybe he would have an idea of what perimeter meant. He did. The young man explained to his peers what he understood it to mean. I then let them loose and told them to find the perimeter of four things. Desks, books, chalkboards, and the tiles on the floor were all measured by the eager fourth graders. I walked around and watched impressed as the lesson seemed to take on a life of its own. “Wow!” was all I could think. This is what teaching is all about. That had to be the best lesson I had the entire internship. As perfect as that had turned out, everything else was less than perfect. I realized as I debriefed with Clayton that more than one thing needed improvement; class management, planning, time management, and organization. I accepted the criticism easily. Clayton made it easy. She was very supportive and encouraging. A positive comment would always be given prior to the not so positive comment. Clayton was sweet, caring, and concerned about me as a teacher-to-be. Her comments always were helpful and aided me in seeing myself as a teacher from a different perspective. The whole internship was invaluable to me as a teacher. It gave me time to “work out the kinks” in my teaching practices. The internship allowed me to make mistakes so that they were not devastating. My eyes were open wide so that I could improve each time. I
am grateful to Mrs. Clayton for investing her time, energy, and experience on me. I know that it was worthwhile.

I had taken over completely about four to five weeks into the semester. I was responsible for all the subjects now. This included calling home, getting copies, planning, and everything else that teachers deal with day after day. Classroom management and planning were the two chinks in my teaching armor. Mrs. Clayton continued praising my strengths which were my questioning skills and the level of my content knowledge, while encouraging me to work on the other two weaknesses. I will say it again, the internship was invaluable to me. It has made me the teacher I am today.

The highlight of that last semester was the field trip to St. Augustine. Florida and its history was the topic being studied during social studies. What better place to go than the oldest city in the United States? I was looking forward to the trip because I had never been there. This would also provide a different way of interacting with the students. I would be a chaperone.

We left early on a chilly morning from Tallahassee and headed east on a charter bus towards St. Augustine. We explored the entire city once we arrived. The Florida history museum, the Ripley’s Believe It or Not! Museum, the fort, and the old town with the oldest schoolhouse in America were interesting to see. Getting the background from the guide about the coquina covered fort was fascinating as well. I had a great time exploring the city with my former students. The trip showed me that learning can occur anywhere. The semester ended. I said my goodbyes to Mrs. Clayton and to her students. I was ready to be an elementary school teacher.

I was hired as a second grade teacher at Hawks Rise Elementary in the northwestern part of Tallahassee. However, I will return to that part of my
life when I discuss my experiences as a teacher. While I was teaching, I saw a yellow flyer hanging on a bulletin board in the office. I picked it up and was immediately interested. The flyer described a special program for elementary educators to earn their masters degree in science education. Science always fascinated and interested me so I called for details. By the spring term of 1996, I was a graduate student at Florida State University. This was when I remember clearly learning about the theory of knowing known as constructivism. In the course Technology for Teachers, constructivism was evident. The instructors employed many teaching practices that exhibited their belief that knowledge is something that is constructed by the knower through discourse and opportunities to make sense of things. I enjoyed this class because it was familiarizing me with new forms of technology as well. I learned how to make web pages, use Powerpoint to present a multimedia report, and how to use the Internet more effectively. One of the culminating assignments was to construct a concept map out of the nearly sixty words (probably more) that we had learned over the duration of the course. To make matters more difficult, the assignment was to be done in groups of three to four and a presentation as a group would be required. The instructor explained that everyone in the group was to participate and we were to come to a consensus on how the map was developed. For the first time, I could see with my own eyes what people do in their minds; make connections. Examining this web of words and explaining this conglomeration of terms to those not involved in the process was difficult and challenging. I appreciated how the task made me think in a new and different way. This was only the beginning of my experiences with constructivism.
As I continued as a graduate student, I learned more and more about how to implement this epistemology into my future classroom. In the fall of 1996, I was introduced to one of the most difficult, most frustrating, yet most rewarding classes I had ever taken in my career as a student; Physics for Science Teachers. There would be two components, the one I was taking in the fall and another in the spring. I know I had preconceived notions when I first walked through the door of the small classroom. I noticed two rows of black-topped science tables, four in each row. There was nothing extraordinary about the classroom. I chose a seat near the back of the room. Two other people sat next to me. We waited as the professor made his way up front. He introduced himself as Dr. Paul Cottle a professor in the physics department. There were two other gentlemen inside the room but I paid them no mind. The professor explained what was special about this course. I don’t remember his exact words. However, he did say that this was no ordinary physics class. First of all, it would be geared for teachers which meant that it would not be mathematics intensive. I was glad to hear that. I had had enough of that subject for a lifetime. Secondly, the professor stated that group work would be a large component of the class. Thirdly, these gentlemen would be conducting research on the whole experience. I believe we reviewed the syllabus and asked and answered questions. I was apprehensive about the mathematics but eager to get started on the physics. I had not thought about physics since high school.

I went to the bookstore to pick up the only textbook of the class. An extremely large, white book, which I still own, costing over a hundred dollars is what I needed. The next class consisted of hands-on activities and much discussion. We made sense together about what he had learned by doing the activity. I noticed something. As we worked collaboratively or
individually, the professor would walk around and just ask question about what we were doing or what we thought was causing what we were observing. He never confirmed a right answer or even a wrong one. I remember asking, “Am I right?” The response would be, “What do you think?” or “Do you think you are right? How do you know?” Cottle never answered any of my questions. When he did, I would have another question instead of an answer. It was annoying, to be honest. I figured that it must be a personality quirk and decided to think nothing of it. This time homework was assigned out of the large and costly textbook.

When it was time to begin working on the problems, I began to realize that I did not know as much as I thought I did. There was some algebra and trigonometry with these problems. My mind had been shut off to math a long time ago. I struggled with these problems. I struggled with the quizzes. There were no multiple choice questions. They were all essays. I had to explain, describe, analyze, diagram, label, and compare. This was new to me. Learning in science had never been difficult for me. I always enjoyed it and had a “knack” for memorizing the correct formula or word. Now, I had to show my understanding through my explanations. I turned in my quiz and headed out the door.

The next class, Cottle was distributing the quizzes taken from the previous class. I had a number on the top and it was not a very large number either. I walked up to the professor, “What does this mean? I don’t understand what this number is telling me?” He answered me, “This tells how you did. You receive a certain number of points per question based on the depth of your explanation.” Incredulously I ask, “So, you’re telling me this is my grade?! I failed? I didn’t get any points?” I don’t remember what he said. I could not believe I had fared so poorly. I pushed it to the
back of my mind. Cottle informed us to get together with our group and talk about the problems. “What did you get for number 1?” Someone in my group answered. The discussion had begun. “How did you get that as your answer? Show me.” That person did and our other members began to get involved. They shared how they figured out the problem. She explained and the rest of us listened. This part of the class is what I really enjoyed. Never in my elementary courses had we worked so well. This group worked well together. In my previous experiences with group work, it was more like “you do this and I will do this.” In other words, people working independently in groups, if that makes sense. However, in physics for teachers, I felt like we all wanted to know and learn, so we all contributed. It was like we were all in the same boat and we were all rowing in the same direction with the same destination in mind; learning, understanding, knowing. In my other classes, we were thrown into the same boat but we weren’t rowing together with the same objective. Some wanted to pass the class, others wanted to know, and others just did not care. It was frustrating working like that. This group, however, was not the same. I enjoyed discussing the science and seeing the same problem from someone else’s perspective. If there were disagreements, we would discuss, dialogue, and even argue until we all agreed or until we all agreed to disagree. This group was unique in that one of the members was conducting research while being a member of the class. So, during discussions, there would be a tape recorder which we all learned to ignore. I learned more about myself because of that recorder by the end of the classes.

Every other class, I would receive another quiz with a low number telling me that I did not do well, again. Frustration was mounting. Exasperation with the professor who never answered questions was increasing. Anxiety
during quiz times became unbearable. I could not stand to look at another failing quiz. I was tired of putting forth all this effort to learn and receive nothing in return. This class was pushing me to my limits.

One day, it changed. The quiz I received had the highest number I had seen on it. It wasn’t the highest of the high but it was good enough for me. It was not full of red comments that told me I was not speaking the “right science language.” For me, it was like being nearsighted and someone offering me a pair of prescription glasses. All of a sudden images become crystal clear. Everything started making sense. I was speaking the “right language.” I was succeeding in this science class. I was beyond pleased with myself. This class stretched me and my mind and I met the challenge.

A surprising aspect of this class after it was over was what I learned of myself through someone else’s research. One of the group members, handed me the thick manuscript and asked me to read it. As I read, although the names were changed, I realized that it was a picture of my physics class. I felt like a fly on the wall as I read the dialogues. I recognized phrases that I had used and I began identifying all the group members. I continued to read. I was surprised to find that every time we worked on problems that were beyond my understanding I would begin off-topic conversations or say something silly or stupid to get everyone off-track and distracted. Quotation after quotation, it became evident that this is what I would do when concepts became too difficult. It was eye-opening. I was looking at myself from someone else’s eyes. I was disappointed in myself as I finished her dissertation. “Wow, I did not realize that I did this when things got too hard,” I said, more to myself than to anyone else. Questions popped in my head, “Why do I do this? What am I trying to accomplish? Is this what it feels like for students who don’t “get it?” That research did so much for my
understanding of myself, I will never forget it. I went to her dissertation defense and had the opportunity to share my insights and thoughts. I will treasure that moment because it permitted me to take a look at me in a way I had never ever done before.

After completing this class, I understood in a real and practical way what this constructivistic theory of knowledge was all about. I promised myself that I would never forget the feeling of helplessness and hopelessness in being in “a strange and foreign land,” otherwise known as a science classroom. I swore that I would be more vigilant of my defense mechanism of distracting others when I felt “lost” or confused. I had learned new ways of dealing with this “lost-ness.” I could make sense of things and I had others with whom I could make sense as well. The teacher was not the ultimate authority. I could learn with or without him. Professor Cottle, through this course, displayed my overdependence on the teacher. I believed that he had all the knowledge. He seemed greedy during the course. He was not sharing all the knowledge he had. I learned that knowledge is not something contained within one person’s head and able to be passed to another head. Knowing was making sense through talking with others and dealing with misconceptions. Learning could happen with or without the book or even the teacher. This class broadened my horizons. It gave me a clear view of what it is like to be a struggling learner. I am a much more effective teacher because of that course. I have a better understanding of learning and teaching because of that exceptional class.
CHAPTER 5
LOOKING BACK-A TEACHER’S PERSPECTIVE

My first couple of years teaching could be encapsulated by one word and one word alone; survival. My first day of teaching I remember thinking, “Where is the teacher?” I quickly realized I was the teacher and so began my journey. Excited, scared, apprehensive, unsure, overwhelmed, and exhausted are just a few of the words that I was feeling that first week of school at Hawks Rise Elementary. I was finally a teacher, a second grade teacher at that. There were 22 little faces staring at me that day and I survived. My head was full of big ideas that I had learned in college. I wanted to make a difference. I wanted to be a good teacher.

How would I go about doing that? Try something and see if it works, if it works, then it must be good. I experimented with different behavior management techniques. I bounced my ideas off the other second grade teacher who was an immense help to me, Ms. Snowden. She was very supportive and encouraging. She was willing to listen to the days when things did not go well. She shared in my joys when things went well. I believe my first year was really when I began to learn to teach. I never realized and was never really prepared for the onslaught of paperwork, parents, parties, and principals. I was grading papers before, during, and after school and I was still behind after all that. I figured this is what I signed up for so I resigned myself to all the hassles.

Unfortunately, my contract was not renewed for the following school year and just like that, I was not a teacher. I never understood why I was let go. I moved on. I decided to focus on the graduate program in which I had just enrolled at FSU. I would be a full-time student again and work part-time.
As I finished off my coursework, I was ready for a change of scenery. I decided to head south to something more familiar and where more money would be offered. I moved to South Miami and began teaching fourth grade at Whigham Elementary. I had high hopes and big dreams.

September 2\textsuperscript{nd}, 1997

Today is the first day of school. I’m a little nervous but hopefully the butterflies will be gone by this afternoon. I’m sure I’ll have a lot to reflect on later. I want to make sure I think about why I choose to do certain things the way I do. My heart’s desire is to become a better teacher. This is my proving ground. I look forward to it with great expectations. I hope to make a difference in these kids’ lives. I may be too much of an idealist but that’s what I want. Here we go.

I wanted things to go well and for a while they did. However, things change. As the year progressed, I noted patterns of behavior in these kids. Disrespect, talking at the wrong time, no homework, disruptive behavior, and rudeness were just some of the problems I experienced weeks later.

December 8, 1997

What amazes me the most about the past three and a half months is that I’ve continually had to deal with the same discipline problems: people talking, being disruptive and rude. I’m still dealing with it. The point of all of this is to be a better teacher. How many more way can I fight this lack of discipline/rules in these kids’ lives? I have tried so many different things. I’ve forgotten what I started out with. That confuses me.

This was the pattern in my teaching for quite some time. Teaching elementary school had its ups and downs. There were times when “everything was clicking.” My students seemed to be on the same page as me and learning was happening. I loved those times. I was making a difference. Mathematics and science made up most of those times. Those
two subjects made the most sense to me. I could come up with “hands-on”
activities that engaged the students’ attention.

September 7, 1997
One positive note to mention in science, I assigned an experiment in
density at home over a teacher work day. The majority of the class
participated and enjoyed it, girl as well as boy. That was exciting.
What I think I should have done was open up the experiment up to
them by allowing them to come up with questions of their own.

September 14, 1997
What I want to write about is my science lab with water. I’ve chosen
to begin with water seeing that that is the focus of the school. I was
pleasantly surprised to see how well the lesson turned out. It was on
surface tension. They kept track of how many drop would fit on a
penny. They worked with partners. I received many compliments on
how “fun” it was. I enjoyed just watching them and questioning them.
Some [students] of their own accord illustrated what was going on.
They were required to make a guess and then record the actual
number [of drops of water]. They were challenged to see how many
drops actually fit on the penny. Forty-one was the highest. I want to
revisit that experiment and some differing variables and see how they
react to it. Hopefully, that will bring us to surface tension.

Unfortunately, the hard times were more numerous than the easy times
where learning was occurring. Page after page in my journal shows my
frustration with my inability to deal with talkative, energetic fourth graders.
I made many mistakes. I raised my voice, also known as yelling, more times
than I care to admit. I learned over the course of that first year that was a
very ineffective method to deal with misbehavior. In my mind, I had to
make it to the next weekend, to the next workday, the next vacation. I had to
survive.

The survival mentality continued. Instead of 22 students, now there were
32 students. Parents, a rare sight, were part of the problem now and
discipline was a major problem. I was frustrated at the end of my first year
because I felt like I had done so little teaching. I spent my time dealing with
discipline problems. My high hopes and big dreams were deflated. I was
beginning to feel useless and ineffective. Wasting time is what I felt I was
doing; especially mine because my students were not learning the way that I
knew they should and could.

Would it change? Could I improve my teaching next year? Every year
had its own flavor but discipline and class management always reared its
ugly head. Teaching was taking its toll on me. I was changing into someone
I did not like. My wife came to visit one day during class. She asked me if I
knew that I was not myself when I was teaching. I told her that I was not
myself but I did not know how to change it. Year after year, my frustration
levels increased. Now, it was more than just the students. The parents,
some who had blamed me for their child’s failure, were part of the problem.
The administration did not back up my choices as a teacher.

One day after school, a student and his mom walked into my office, also
known as my closet, and asked me if the student was to serve a detention
which he was. Mom said that her son was walking around lost because he
did not know where to go to serve the detention. I am not quite sure where
else the student was to serve a detention besides my room, but no matter.
The parent did not want to hear that. She was upset and angry. I retaliated
with raised voice. She left. I calmed down. I spoke to my principal and
explained what had happened. I was willing to apologize for losing my cool.
I asked my administrator to set up an appointment. She never did. The next
day, that student was moved out of my class into someone else’s class. The
problem was never resolved. This was what was done on a consistent basis
at this school. Parents did not like you, as the teacher, the student would be
moved. What message is this sending to your staff? I got the message loud
and clear. From that point on, I dealt with my problems on my own and I left the administration out of it. What help would they be anyway? I believe this was the “last straw” that broke this camel’s back. I was ready for a change. How about middle school?

Teaching-Middle School Science

In my mind, the one word that would define my teaching would be that of a facilitator. My job as a teacher is to connect students to their learning of science. I do that by providing an environment in which questions can be asked and answers can be solved or at least attempted to be solved. I circulate around the room during laboratories and ask questions. Different questions will be asked depending on the situation. If I am attempting to get the student headed in a different direction, I ask simple, close ended questions. However, if my attempt is to get them to think, then I will pose a question that is more higher order and open ended. I think that is my objective as a teacher. I want my science students to think. Not just think, but think for themselves. I desire them to become problem-solvers.

My ideal would be to have students that just have to know. They have a problem and they are looking for solutions without being spoon-fed by me. I want them to figure things out and make sense for themselves.

The best way to explain the way I see myself as a teacher would be to give an example from my class today. I believe that who I am as a teacher will show through this retelling. Today, we dissected owl pellets. However, the students did not know what it was that I had just placed in front of them. I handed out to each team of four students an object that was wrapped in aluminum foil. It was interesting to hear the “Ewwws! That is so gross!!” as they unwrapped the foil like an unwanted gift. In their minds, they had
decided they knew what this stuff already was—feces, poop, crap, and the like.

After the pellets were distributed among the teams, they were given the directions on what they were supposed to do. First, they were to measure the pellet’s length, width, and mass. The necessary tools, triple beam balance, rulers, magnifying glasses, etc. were on the table so that they could get started right away. They were instructed to make observations of the object and to write it all in their journals.

So, I began walking around the class making sure the students were using the balance correctly so that they got an accurate measurement. I stopped by the team closest to the door and started listening to the conversations. The question on everyone’s lips was “What is this stuff?” “Will I get sick from touching it?” asked one disgusted student. My reply to these various questions was, “I don’t know, what do you think it is?”

Five minutes pass, I remind the students to write down their observations, and more importantly, their predictions which had already been made clear by the looks on their faces.

Some students begin picking it up and smelling it while others keep their distance. I continue asking questions. “So, what do you think this stuff is?” I ask. The student replies, “I think it is owl poop.” “What have you observed that proves that?” I ask. “Well, it smells funny. And it’s shaped like poop”, answers the student. “Write those observations in your journal,” and I move on to the next team to see where they stand.

Once I have made my rounds, I repeat the process stopping at each table asking more questions, getting students back on task, or clarifying something that was misunderstood about the directions on the board.
I stop at another team that has completed their observations and are now dissecting the pellet. I listen, “Hey, I see some bones! Here are some more,” exclaims a now interested student. I ask, “What did you predict this object was?” “I thought it was owl crap,” says the student. “Do you still think that?” I ask in reply. “Yeah, I do. Because all I see are bones and this brown stuff. So, I think it is poop.”

I hand him a bone sorting chart so that they can begin to understand what they are looking at. “Can you figure out what kind of bone you are looking at?” I say. The student grabs the chart and his other team members gather around. They compare the bone that they have to the ones on the chart. They decide that they have uncovered a rodent’s skull. I ask, “How do you know that it is a rat’s skull and not a mole’s or a shrew’s?” They show me on the chart and start pointing out the incisors of the rat’s skull. One student states, “It doesn’t match any of the other skulls so it must be a rat. Look at the differences between a mole and a rat.” He shows me using the chart. “OK, what does this tell you about the object? What is it then? Do you still believe that it is owl poop?” Silence. It seems as if he is thinking. “Maybe some animal ate this rat,” he asks more than states. “What other bones are you finding?” One of his team members pipes in, “Look at this skull, I think it’s a bird”. “So, you have a bird skull and a rat skull in all of this fuzzy stuff. Any ideas? What do a bird and a rat have in common?” “They’re small,” says one student. “They live in the forest,” says another. I jump on that statement. “What else lives in the forest that may have eaten the rat?” I ask. Now some light bulbs are going on in their heads. I ask another question to stir them some more. “What other things do these animals have in common besides being small and living in the forest?”
Some puzzled looks but one student seems deep in thought. “Well, the chart shows moles, shrews, mice, and rats. Don’t they eat at night? What’s the word for it?” The thinking student says, “Umm. . .nocturnal, right?” “OK, What else is nocturnal that eats these kinds of animals?” She gets it now. “Oh, I know, an owl. They eat mice, rats, and all those other animals.” “Now, you are on the right track. What other conclusions can be made with the evidence in front of you? How did the owl make this stuff? Keep thinking and talking. Let me know when you have some more ideas.” I walk off to another team to see what they have discovered and concluded.

I believe this little piece of that day shows what I believe about myself as a teacher. I enjoy what I do and it is evident in my attempt to make science meaningful and fun to them. I am involved with the students and their learning. I do this by circulating often and speaking to a team of four students at a time. This gives them the opportunity to share their insights, ask their questions, and interact with me on a one to one basis. I believe this also shows that science is a process of asking questions and trying to find answers that are not always easy to find. The best part of the process is the sharing of thoughts and ideas with each other which is why I have them sitting at teams. Talking about the science that they are learning is crucial to their understanding and comprehending it.

My most important tool in being a science teacher is my ability to ask thought provoking questions. This is the “spur” I use to get them going. I do not like to give a lot of answers to questions. Instead, I ask more questions of them so that they continue thinking which a good deal of students hate. They claim they would rather me tell them the answer. Where is the fun in that? I believe the students actually like it when I do not
give them answers because they are figuring it out for themselves and that makes it more meaningful to them. Thinking, solving problems, answering questions, and having fun while doing it is what it is all about for me as a science teacher.
CHAPTER 6
MY STUDENTS’ PERCEPTIONS

My beliefs about science play an important role in how I go about teaching and helping my students learn. However, I am only half of the equation. My students’ beliefs and perceptions about science and my science teaching play a major role as well. I wanted to learn about these inclinations, thoughts, ideas, and conceptions so that I could better serve them and get a better idea on what they, as students, considered effective. I did this by distributing a survey consisting of ten questions. These questions were statements with which they could strongly agree, agree, disagree, or strongly disagree. I included statements that would give my students an opportunity to share their beliefs about themselves as science learners; statements such as “I am a good science student,” and “Science is one of my top three favorite classes.” Other statements such as “I like ‘figuring things out’ for myself rather than having the teacher giving the answer,” or “Discussing the labs and working with others helps me do well in class,” gave me a window into their thinking about the way that they learn science best. “My teacher sets a good science learning environment,” lets me see what they think about how I set up the class; at least vaguely. I administered this survey to all of my eighth grade science classes. I then tallied each of the periods to get a table of the all the classes surveyed. The following table shows the total number of students surveyed and how they responded to each question.
<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am a good science student.</td>
<td>8</td>
<td>75</td>
<td>31</td>
<td>6</td>
</tr>
<tr>
<td>2. I do my science homework each night and I feel it is helpful.</td>
<td>15</td>
<td>52</td>
<td>45</td>
<td>8</td>
</tr>
<tr>
<td>3. I pay attention in class and participate regularly.</td>
<td>25</td>
<td>85</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>4. Hands-on labs are the best way to learn.</td>
<td>59</td>
<td>53</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5. Discussing the labs and working with others helps me to do well.</td>
<td>47</td>
<td>68</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>6. Science is one of my top three favorite classes.</td>
<td>15</td>
<td>31</td>
<td>46</td>
<td>27</td>
</tr>
<tr>
<td>7. I learn better by doing science rather than just hearing about it.</td>
<td>62</td>
<td>38</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>8. My teacher sets a good learning environment.</td>
<td>42</td>
<td>62</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>9. Hands-on activities have helped me improve my science learning.</td>
<td>20</td>
<td>72</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>10. I like figuring things out rather than the teacher giving me the answer.</td>
<td>15</td>
<td>52</td>
<td>34</td>
<td>15</td>
</tr>
</tbody>
</table>

For example, I found that my second period science class believed that they were good science students; two strongly agreed, twenty-two agreed, and two disagreed. No students strongly disagreed with that
statement. Most students in that class preferred “hands-on” labs as the best way to learn science. Fifteen students strongly agreed with statement. Ten students agreed and one student disagreed. The majority of the class stated that discussing the laboratories and working with their peers helped them do well in class was important. Twenty agreed and six strongly agreed with that statement. I would assume that all these positive statements reflect that science was one of their top three favorite classes. I was surprised to note that ten students either strongly disagreed or disagreed with that sentence. The remaining sixteen agreed or strongly agreed. The statement on the survey discussing whether they as learners liked “figuring things out” showed that five strongly disagreed, four disagreed, sixteen agreed, and one strongly agreed. The students’ perceptions about the science learning environment was met with twenty-five strongly agree and agree and one strongly disagree. From this survey, speaking solely to the results of my second period class, I see that students believe that they are good science learners that prefer “hands-on” labs in which they could discuss what they learned with their peers. They believe that I set a good science learning environment where “figuring things out” for themselves was met with mixed results. I wanted to know more about their thinking about science and how they learn it well. The survey gave me only one piece of the puzzle. The students were also given a questionnaire consisting of five open-ended questions. Question one asked “How would you describe your best way of learning science? Why is that the best way for you?” Some of the replies stated:

The best way is labs because when you do sheets [worksheets] you might get it wrong. When you do labs you have numerous people which can help you.
Well, by doing labs ‘cause I have fun and you want someone to learn the best way it’s by having fun at the same time you learn.

My best way is with a group so that we can help each other.

Watching videos and doing labs help me. I am a versatile learner.

To me the best way of learning science is by doing labs and discussing the answers because you can do things and see other people’s point of view (conclusions) [word in parentheses belongs to the student]

The best way for me to learn science is by class discussions, labs, and hand-on activities. It helps me to really understand the subject, and give my thoughts and opinions on it.

Based on these replies and others like them, the students believe that “hands-on” laboratories are the best way to learn science. Discussing what they learned in groups aids them in learning science well. This fits with what I have learned to be effective teaching.

Valuing the idea that knowledge is constructed by the learner guides educators in the development of resources and in the presentation of experiences for learning that take into account the learner’s role in making knowledge his or her own. If it is recognized that students’ participate in the construction of knowledge in science, then we are careful to create experiences and opportunities that enhance the learner’s participation in the process. (Shapiro, 1994, p. 5)
The second question on the questionnaire asked the students to think about the teacher. It asked, “Does your science teacher help or hold back your science learning? Explain what you mean.” Just a few of the replies:

He definitely helps my science learning he better defies [defines?] it when I don’t understand the question or subject.

My science teacher helps me when I need help. If I have a question about assignment I’m doing he’s by my side to help me.

He helps my science learning because he explains well until we understand and he uses labs as a way for us to understand.

My science teacher helps me learn new things. For example, when he put a video about space, I learned that when you see the rays of the sun you’re seeing how it was 8 minutes ago.

Some students identified the laboratories that the teacher uses to help them to learn and understand science. Most of the other students in my second period class stated that the teacher would help them when they didn’t understand a question. Unfortunately, these quotes from second period gave no more insight into practices that the teacher employed that they would consider effective or even “good.”

The fourth question on the questionnaire delved more deeply into what things they would improve or change about the class. “What could your teacher improve or change about your science class so that you benefit?” The answers,

Could make learning more interesting and try new ways to teach.
More labs.
Well, he doesn’t need to improve anything.
It should be more fun and exciting if he change it.
My science teacher can change the way he’s so hard on me.
My teacher could improve or change the fact that we only have a little bit of time to do some labs. I would benefit because I could have more time to do my lab therefore I would learn more about the lab.

According to the responses, some students claim to be happy with the way things were in the class. Others desired more labs and more time to do them. Overall, the students were content with the class setup and stated that nothing needed to change.

The results were still unclear. There were more questions that I wanted to ask. I decided to conduct some interviews of various students according to their ability levels. I chose three students and asked questions similar to the survey and questionnaire for more insight into their beliefs and ideas about science, science learning, and science teaching.

I began with Maria. Maria was one of my higher achieving academic students based on my observations of her desire to learn and her grades in that science class. She was asked, “What are some keys to success in science?” I found that she believed that there had to be certain qualities in herself, in a science class, and in a teacher. Beginning with herself, she expressed high interest in science. “If you don’t like it, you’re not interested in it [science], then you won’t learn.” Maria expressed a desire of wanting to know, to learn about all the topics covered so far which is why she asked so many questions. Learning things for herself was very important to her. This is what made science so enjoyable. The laboratories and experiments
themselves made the class highly interesting to her. She highlighted a couple of experiments that she really enjoyed. “It’s better than sitting listening to someone talk all the time. That’s boring. You’re class is fun. We get to do stuff and figure things out. Talking is okay in your class. I get to share my ideas and listen to someone else’s ideas.” Collaboration with her peers during laboratory work made science fun. Discussing ideas and listening to other people’s viewpoints was held in high regard by Maria as well.

The role of the teacher in Maria’s estimation was that of a helper. “If I’m confused and don’t get it, that’s when I call on the teacher. I don’t want him to give me the answer. I want to figure it out for myself.” As a helper, the teacher was to clarify topics. Answering questions, explaining ideas during lectures, and setting up labs to help her learn were the jobs of a science teacher. When asked, “What would you change in your science class or science teacher to improve them?” She stated that she liked the class and the teacher the way they were. She would change nothing.

Out of curiosity, I asked about her home and parents. She explained how learning was extremely important. She was expected to bring home A’s and B’s and nothing less. Maria’s parent were involved and asked about her progress and homework. She stated that they were a big motivation to do well. “My parents came from Cuba. They want to see me do well. They understand that school is very important. That is why they expect those high grades. My parents want me to do things they could never do.” Maria stated that she does well in school because of them as well as for herself.

Isabel was the second student interviewed. I chose her because she started the year off so poorly. She failed the first nine weeks. However, after getting in touch with the parents, I began to see improvement. She had made drastic changes in her study habits. Homework was being completed.
Effort was being shown by the quality of her laboratory write-ups. She was even asking questions that showed that she was engaged in learning. I would characterize Isabel as an average student. I believe her motivation was not as intrinsic as it was for Maria. Isabel had her parents watching and remaining involved.

Isabel answered the questions similarly to Maria. The class was fun because there were labs that “let you do something instead of just listening all the time and writing notes.” Isabel also appreciated the time set aside for discussion with her classmates about what was happening during the experiments. These were all qualities of the class that made it “fun and not boring.” As stated before, there was also a high level of parent involvement in Isabel’s life. She stated that they were concerned and “. . .did something about my failing your class. They weren’t happy.” This was noted by the dramatic change in this student’s approach to the class. She stated that she now enjoyed it and was learning new things.

My third student was a below average student who constantly was getting into trouble because of how easily he got distracted. He was in my third period class which was one of the largest classes I had that school year. There was no place in that room that Miguel could not find something other than work to do. He was a likeable student although he would be reprimanded often. As far as I could tell, he never did anything out of meanness or spite. It was as if he could not help but get into trouble.

I met with Miguel and asked him the same questions that I asked Isabel, and Maria. He stated that he liked science because it teaches him things that he didn’t know. He recalled a lesson on space and the planets and stated the number of moon that Jupiter had. When asked “What is the best way to learn science?” he answered that the teacher is the person that helps him
learn best. The teacher’s use of illustrations and examples helped to make things clear so that he could understand. He said that he liked science but sometimes “I fool around too much.” Miguel also liked the groups being able to talk about their work and their findings. He said, “you get ideas from your team and that helps you to understand.” Although he claimed that the teacher was responsible for helping him to learn, there were times that he would prefer to be left alone “to do it myself.” He remembered trying to understand, by himself, why oil and water did not mix. He never said he did figure that out. Miguel also stated that “I don’t want to fail. I know I can do better. It’s just sometimes I fool around and then I don’t get my work done.” He wanted to succeed because as he said, “I am the only one in my family that has never failed. My sister dropped out and she doesn’t have no diploma. My brother did that too. He tells [me] not to follow his path.” Miguel did not express any major involvement with his parents and his schoolwork. Overall, Miguel said he likes science because the work is “not difficult” and that he understands most of the time. He could not, however, put into words why it was that he chose “fool around” when he thought that work was “not difficult.”
Summary

After reviewing all the data collected from the surveys, questionnaire, and the interviews, I begin to see a pattern of what students believe to be a good science classroom and a good science teacher. A good science teacher makes a good science classroom by providing opportunities to explore and “figure things out” through the use of “hands-on” laboratories instead of worksheets or questions at the end of the book. The laboratories were considered “fun” by most of the science students surveyed. Discussion about the lab was considered important and helped their understanding. The teacher was to only clarify and explain through the use of meaningful and relevant examples. He had to give time to work through the labs together in a group. Most of the students stated that they would not change anything about the science teacher because they were content with the way he was teaching.
CHAPTER 7
NATIONAL BOARD’S PERCEPTIONS

According to the National Board for Professional Teaching Skills (NBPTS), teachers should know and follow these five core propositions:

1) Teachers are committed to students and their learning.
2) Teachers know the subject they teach and how to teach those subjects to students.
3) Teachers are responsible for managing and monitoring student learning.
4) Teachers think systematically about their practice and learn from experience.
5) Teachers are members of learning communities.

Each of these propositions encapsulates what the National Board believes to be effective teaching practices. Looking at the first proposition, it states that teachers should make learning accessible. No students should be denied access to learning which means that the teacher treats each of his or her students fairly. An effective teacher believes that all students can learn. Believing that, then the teacher will take into account the individual differences that each student brings to the table. Caine and Caine (1991) support this by using an example from Gardner’s work with multiple intelligences.

Howard Gardner’s (1985) “seven intelligences” is perhaps one of the most useful models to have emerged out of the controversy over learning styles. . .Gardner’s model of seven intelligences takes us away from our outmoded focus of on only logical-mathematical and verbal intelligence. He suggests that the different intelligences are linguistic, musical, spatial, body-kinesthetic, mathematical, interpersonal, and intrapersonal. [p.35]
Teachers need to be aware of the various intelligences that students bring to class on a daily basis. Once aware, then the teacher should design an environment that will give the student success and not failure. The teacher creates lessons and activities that play towards the student’s strengths.

The second proposition states that teachers should know their subject and know how to teach. In other words, teachers should have high content knowledge and high pedagogical knowledge. There are teachers who know voluminous amounts of information pertaining to their particular subject but have no idea how to make that information “accessible”. The reverse is true especially in elementary teachers, pedagogical knowledge is strong but content is weak. So, what is observed is a fear of that subject. The students do not receive the necessary instruction or worse yet, the students are taught content full of the teacher’s own misconceptions. There is a gap between teaching knowledge and content knowledge resulting in ineffective teaching.

Teaching effectiveness is dependent upon the interaction between the instructor’s subject-matter knowledge and teaching (pedagogical) ability. The following scenarios illustrate the nature of the complex interaction between these two critical variables:

1. An individual may possess a substantial amount of subject-matter knowledge, yet be unable to design and implement instructional methods to enhance student learning due to a lack of pedagogical ability.

2. Conversely, an individual may possess some generic pedagogical skills, yet have limited subject-matter knowledge and again be predisposed to ineffective teaching.

These scenarios indicate that it is impossible to be an effective teacher without being competent in both subject-matter knowledge and pedagogical ability. Consequently, subject-matter knowledge
remains a necessary prerequisite for effective teaching, not the sole determinant. (Bulger, Mohr, & Walls, 2004, p.2)

The third proposition stated by the NBPTS is that the teacher is responsible for managing and monitoring student learning. Organization of instruction is under the teacher’s control. He or she maintains a learning environment in which learning is highly valued. The teacher finds ways to engage the learner and keep that interest so that learning goals and objectives are met. The National Science Standards (NRC, 1996) echo this proposition in Standard D of their policy statement, “What Teachers Should Know and Be Able To Do”,

Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science. In doing this, teachers

- Structure the time available so that students are able to engage in extended investigations.
- Create a setting for student work that is flexible and supportive of science inquiry.
- Ensure a safe working environment.
- Make the available science tools, materials, media, and technological resources accessible to students.
- Identify and use resources outside the school.
- Engage students in designing the learning environment.

The fourth proposition states that teachers systematically think about their practice and learn from their practice. Teachers learn from their mistakes. For that matter, teachers learn from their successes. In other words, effective teachers are reflective. They, in retrospect, think back to what they could and should have done differently during a science lesson.
Thinking. . .was stimulated when I encountered some kind of doubt or perplexity; Dewey (1933) likened it to coming to a fork in the road: “reflective thinking. . .involves (1) a state of doubt, hesitation, perplexity, mental difficulty, in which thinking originates, and (2) an act of searching, hunting, inquiring, to find material that will resolve the doubt, settle and dispose of the perplexity (p. 12)” (as cited in Barrell, 1991, p. 10).

Teachers, during and after instruction, can come to this “fork in the road” while teaching and reflecting on what they did or did not do will help them to become a better teacher. He or she won’t spend so much time working on that particular activity. In so doing, the teacher and the students benefit. Schon (1987) discusses the same idea using different terminology.

Reflection-in-action has a critical function. . .We think critically about the thinking that got us into this fix or this opportunity; and we may, in the process, restructure strategies of action, understandings of phenomena, or ways of framing problems.

Reflection gives rise to on-the-spot experiment. We think up and try out new actions intended to explore the newly observed phenomena, test our tentative understandings of them, or affirm the moves we have invented to change things for the better. [p.28]

The final proposition by NBPTS says that teachers should be a part of learning communities. The statement continues by stating that teachers should be working collaboratively with other teachers as well as parents; the overall goal being the increased effectiveness of the school. How can teachers expect students to practice inquiry through collaborative groups if the teacher himself or herself does not make a practice of it? It would then become a situation of “Do as I say, not as I do!” As teachers work with each other cooperatively, a love of learning is displayed, the same kind of lifelong learning that most, if not all, teachers want to pass on to their students. One
of the policy recommendations by the National Institute for Science
Education for the effective professional development of teachers
recommends,

Collegiality and collaborative professional exchanges are valued and
promoted. Too often, teaching is a lonely and insulated profession.
Teachers need to support each other and enrich each other’s work.
The school or department should, in turn, support that collaboration:
for example, by encouraging science and mathematics teachers to
work together, to observe and coach each other, to inquire together
into questions of common interest, and to share what they learn from
workshops, conferences, and other professional development
opportunities they have attended elsewhere.

The National Research Council’s National Science Education Standards
(NSES) summarizes its own ideas of what effective teaching is and is not.

Effective teaching is at the heart of science education, which is why
the science teaching standards are presented first. Good teachers of
science create environments in which they and their students work
together as active learners. They have continually expanding
theoretical and practical knowledge about science, learning, and
science teaching. They use assessments of students and of their own
teaching to plan and conduct their teaching. They build strong,
sustained relationships with students that are grounded in their
knowledge of students’ similarities and differences. And they are
active as members of science-learning communities.
Summary

As I reviewed all the standards promoted by the NSES, I noted many similarities between the core propositions put forth by NBPTS. Teachers are committed to their students and their own learning. Teachers “know their stuff.” They excel at pedagogy and content. Active learning is the goal of the interactions between the teacher and the students. Effective teachers collaborate with their peers so that learning is an ongoing process in the teacher.
CHAPTER 8
EFFECTIVE TEACHING IS. . .

Through a series of fortunate events, I find myself in a new setting. I currently teach at Redland Middle School. I am an eighth grade science teacher and have thoroughly enjoyed my time there so far. It has been a long time since I have had this feeling of hope and fun. I like teaching middle-schoolers, most of the time. I can be myself and not an ugly, out of control person like I was before. My goal and desire is the same as it was when I first started teaching in Miami. As I wrote on September 2, 1997 seven years ago, “My heart’s desire is to become a better teacher.” I want to rephrase that. My heart’s desire is to become a more effective teacher.

I believe that I am becoming an effective teacher. The reason that I believe that I am becoming effective is because of what I do in my class. I set the stage for learning. I am becoming more effective because in my practice I am exhibiting on a more consistent basis these different qualities: care, commitment, confidence, creativity, and competence. These qualities were evident in teachers that made a difference in my life. These are things that I strive to convey to my students on a daily basis. These same qualities emerged through the surveys, questionnaires, and interviews. All five qualities that I offer as effective can also be identified within the five propositions that the NBPTS advocates.

I will discuss each quality and give some examples in my practice. Where appropriate, I will add other researchers’ thoughts and opinions on that particular quality. An added note, at times these differing qualities may blend into each other so that in one vignette, one may see more than one effective quality at once. It is even possible that all the qualities will all evidence themselves through my experiences.
Confident

I am confident that students can think for themselves and at other times, think together. I want students to interact with each other, with me, and with ideas in my science class. I believe that students are able to learn if the stage is set in a way that communicates and connects with them. The primary way to go about achieving that goal is to use questions effectively. I believe that questions are a tool to probe understanding, provoke thought, and engage attention. When students ask, “What is that?” or “How does that work?” I will return a question with another question much to the dismay of my students. Answers do not come from me very often. I want them coming up with answers. I want them making sense of the situation and solving their own problems. A couple of answers given by students on a survey states “My science teacher helps by making the stuff that is hard to understand into simpler phrases that anybody can get; Our teacher helps us in any way possible without giving us the answer; My teacher has helped me to understand science. Because he uses all the resources that he has to explain what he is teaching; He helps my science learning because he explains well until we understand and he uses labs as a way for us to understand; Our teacher help us in any way possible without giving us the answer.” Each of these students has witnessed the fact that I believe that they are capable of learning in a meaningful way. I agree with one of the students. I do try to use any and all resources so that the students can make sense of the problem or idea at hand. One of the most important resources I use are effective questions.
Closer examination of constructivist teaching practices reveal that questioning is a critical element of facilitating student construction of knowledge. Questioning by the teacher serves several purposes. First, questions elicit students’ ideas so the teacher can gain insight into student thinking and subsequently plan for experiences that clarify and deepen student understanding. In order for the teacher to “inquire about” or “seek elaboration” of students’ ideas, the teacher must be able to effectively use questions. Second, the use of questions generates discourse between students and between students and the teacher. General agreement among constructivists posits that discourse is especially important to negotiate meaning and socially agreeable constructs. Therefore, the use of questioning to generate discussion is important before, during, and after engaging students in learning experiences. (Levitt, 2002, p. 2)

Questions and the answers from the students give me a better idea on their understanding. Recently, I decided to make my own test rather than use the test that the textbook company offered. On this test were the questions: “Explain the energy conversions that occur during the use of a flashlight. Diagram, label, and explain each change.” and “What is the difference between kinetic and potential energy? What do they have to do with each other? Give two examples to explain.”

By asking this first open-ended question on the test, I observed that a majority of my students did not understand the concept of energy changes and their relationship to the first law of thermodynamics which was asked about later in the test. So, I distributed the tests back to their owners and we reviewed the concept once more. I went table to table asking where they stood on that question. Some could see the problems that they had when they were answering the question. Others still needed clarification. The questions commenced. I asked, “Where is the source of energy for the flashlight?” I received a blank stare. I draw a picture of the flashlight in the
student’s journal. I continued with the questions. “Where is the main source of energy?” Now we were moving because the student answered quickly and easily. “The battery, the battery is where the energy is coming from.” answered the student. “Good, now what kind of energy is found in the battery?” I asked. Some students came up with the correct kind of energy. Others used some help from their friends or even the workbook. Eventually, the student identifies it and we move on to the next energy change. I have her write the word “chemical” into her journal. “How does the chemical energy get to the bulb?” I continue. Now, I could draw on her past experience because she had completed a lab on making simple circuits just last week. “Do you remember the lab last week? What made the bell or the motor work?” I ask. The student thinks and answers. She writes the word “electricity” in her journal next to the picture of the flashlight. I encourage her with my last questions before moving to the next student. “Keep going, what energy change is next? Why does anyone use a flashlight?” I walk off.

Students fared better with the second question than they did all the others. Most students could explain the difference between kinetic energy and potential energy. I believe that the main reason for their success on this question is that they were given many laboratory experiences with potential and kinetic energy. One such experience was when they had to construct a rollercoaster as a team. This rollercoaster had to have at least one loop, one hill, and one turn. Before they began they were told to make a diagram of what their rollercoaster would look like and label the places that they thought there would be either kinetic and/or potential energies. They were given the necessary supplies and were let loose to test their ideas. All of the students had ideas on how to go about making their coaster come to life but ran into some obstacles along the way. They were expected to work
together in order to solve the problems they were experiencing. I walked up to one group of three boys who were having a hard time with the loop. “We can’t get the marble all the way around. It falls off halfway,” they complained. I asked, “What do you think is the reason that the marble doesn’t make it?” One of the boys looks at me and answers, “It doesn’t go fast enough. There isn’t enough speed.” “So, what can you do to increase its speed? Another student on the team seems to be thinking out loud. “What if we make it higher? The beginning would give it energy enough to make the loop.” “Try it and see if it works,” I reply. I stand around a while longer to see if his idea works. They use the counter to raise the starting point of the marble and they release it. We all watch as the marble makes the loop and keeps on going.” All the boys are pleased with themselves as they continue constructing.

These boys and others like them now had some knowledge and experience with kinetic and potential energies that they could draw upon when asked to explain their understanding of why things fall and how a rollercoaster works. By providing these students an opportunity to ask questions on their own and by solving problems together, I believe they have a deeper understanding of kinetic and potential energy than would a student who could recite the definitions by heart and regurgitate the answers on a multiple choice or fill in the blank test. I facilitated my students’ learning by “setting the stage” for learning by not giving them the answers and encouraging them to figure things out for themselves. I don’t believe my job is to be the “fount of all knowledge” spouting all my wisdom to those willing to “come and drink.” Far from it, I believe that my job as a teacher, an effective teacher, is to ask questions, questions that will give me information about the understanding and thought processes of my students. I
use questions to get students to think critically for themselves. I no longer accept regurgitated answers that were memorized to get past the obstacle of a quiz or even a test. Students do this often, especially the ones accustomed to being “spoon-fed” in other classes. What they do when asked a question is respond with science vocabulary they have seen in the book or heard someone else use recently. They seem to think that will satisfy me and I will leave them alone. How mistaken they are. More than once in the last two years of teaching science I have heard, “Why do you ask so many questions?”

A well-asked question not only sparks thought but it can also create discussion and dialogue. When that happens, then thinking, and hopefully, learning is occurring at that time. In my opinion, learning is not happening until that topic or idea has been talked about, argued about, thought about. For example, everyday the students come to class they have a journal topic on the board. They are supposed to think about the question and then write their ideas in the journal. This serves two purposes. One, I begin to see what they understand about that particular topic and what they are still unclear on about that topic. Second, it shows them that science is something more than just facts to memorize and formulas to follow. Now that I think about it, it serves one more purpose. These open-ended questions help to engage their attention on the topic on hand for that day. As I walk around listening to their ideas, I see that some are beginning to grasp the concepts that we have been exploring and discussing in class.

Today’s journal question was based on a discrepant event that was demonstrated to them. On the board I wrote, “Explain what you observe from the demonstration.” I filled two beakers with liquids that the students assumed was water. I also had a cup of crushed ice. Unfortunately, the
school does not have ice cubes so crushed ice had to suffice. I showed and
told the class that what I was dropping into each container was ice. As I was
doing this, I heard them beginning to make predictions. “Oh, the ice is
gonna float!” they said. I dropped the ice into the first container and as they
expected the ice floated. However, as I dropped the ice into the second glass
beaker, there were some surprised students. To their dismay, they observed
the ice sink to the bottom of the container. Now the questions that I love to
hear commenced. “Why did the ice sink? That’s not supposed to happen!”
exclaimed more than one student. The fun part is watching them try and
figure out what was going on in that demonstration. Listening to their
conversations and sometimes arguments lets me know that they are actively
engaged in making sense of that which seems not to make sense. I can see
on their faces that something was not quite right with what they knew and
what they have experienced. “Ice floats in water all the time” is probably
what the students in my fourth period class were thinking. Now they were
observing something that “flew in the face” of their prior knowledge.
Apparently, ice does not always float. Now that my students’ attention was
engaged, we began to discuss ideas on what was happening. My question to
them was, “What is causing the differences that you are observing? Let me
hear some ideas.” I heard various interpretations on the reason for the
sinking ice. Some of the ideas that I heard from my now focused science
students were: temperature, amount of ice, different liquids, and what I did
to the ice by squeezing it. I asked that they draw what they were observing
in their journal. “What makes things float or sink? I asked. More answers
are called out, “Weight, mass, and density.” I jump on that answer. “What
do you mean by that? What is density?” The students are thinking
especially the one who just answered.
Most students can and have memorized the formula that they have seen in their textbooks: Density is equal to mass divided by volume \( D = \frac{m}{v} \). However, few can put their ideas into words or even pictures that show me that they truly understand the concept of density and how it relates to floating and sinking objects. So, my job as the teacher is to continue asking questions that get them to think and make them face the problems with their explanations of why things sink and float. In other words, have the students deal with the flaws of their own ways of thinking. Watson and Kopnicek (1990) put it well,

> However, like a growing number of educators at all levels teach science for ‘conceptual change.’ . . . students are allowed to examine their own experiences, must confront the inconsistencies in their theories. In the process they find the path toward a deeper understanding of heat [or any other science topic], have a great time with science, and refine their thinking and writing skills. [p. 1]

Creative

“Hands-on, minds on” laboratories, discrepant events, and investigation stations are the second means of achieving my goal of getting eighth graders to really think and figure things out on their own. “Students need to be given the opportunities to make sense of what is learned by negotiation of meaning; comparing what is known to new experiences, and resolving discrepancies between what is known to and what seems to be implied by new experience.” (Lorsbach & Tobin, 1997, p. 4) Inquiry-based laboratories are a means to that end. These labs provide opportunities for students to look at what they think and test those ideas against what they observe. Sometimes they are pleased with themselves because their explanations seem to fit with what they are seeing. However, there are times that what they observe in a
laboratory is not what they expect. For those that seem sure of themselves and their explanations, I will probe further to investigate whether their theories fit in other similar cases. Sometimes to assess the soundness of their ideas, I will throw in ideas that do not fit with their explanation. I will then listen to that particular student try to reconcile their ideas with this "monkeywrench." It is a very interesting thing to observe.

Students were answering a question from a workbook. The last question was giving everyone fits. It wasn’t multiple-choice. They had to think and try to make sense of what they were reading. The gist of the problem was that someone who measured his mass in Miami (sea level) found it to be 32 kg. However, when this person measured his mass in Denver (5000 ft above sea level) he found it to be 31 kg. I was listening to ideas on how to explain the discrepancy. The week prior we had learned that mass is a property of matter and therefore remains constant. A student named James had it all figured out. He stated “the higher you go up, the less the gravity.” A lot of the students seemed to agree. So, I threw in a “monkeywrench” by asking, “Are you saying that if someone were to drop a ball in Miami and later drop a ball in Denver that the ball dropped in Denver would take longer to get to the floor than it would in Miami?” The look of bewilderment on his face and other students’ faces was priceless. He realized that his theory did not fit with what he knew of gravity. He kept thinking and that was the goal all along.

If children base their thinking on what they have seen and felt, then their experience must be structured to challenge their erroneous beliefs. If alternative views of scientific principles are not addressed, they can coexist with ‘what the teacher told us’ and create a mishmash of fact and fiction. . .if each child is given a chance to test his or her own model of [thinking] and finds its limits, then a deeper
understanding, without the naïve conceptions, can result” (Watson and Kopnicek. 1990, p.2)

My job is to ensure that thinking is occurring and connections to science are being made. In order to keep my students thinking, I have to find labs that will stir the imagination. Sometimes, I have had to create or adapt labs that would foster this critical thought that I desire for my pupils. Being creative demonstrates that I am thinking and learning as well as my students. On more than one occasion, class veers from the lesson plan. I have a choice at that point. I can fight the “aimless ship” and get it back on course. Or I can go along for the ride, and observe the discoveries that these students make together. I have done both. In my experience, going along for the educational ride is more enjoyable than fighting the “off-course” behavior. When learning makes that unannounced turn, a teacher has to be alert and take advantage of that “teachable moment.” Creativity is a necessary quality to recognize that moment and utilize that instance to foster a love of learning. One student shares a memorable lesson from the school year. “A memorable lesson or activity was the one that you do the aliens. That was so much fun. Everybody has this strange alien. Everybody laughed at each other’s aliens and it was so much fun doing it with different material. It was very creative.” A number of students from my Earth/Space science class identified that as a memorable lesson because it gave them the opportunity to apply their learning in a creative way. The premise of the lesson was to pick a planet of the solar system and create an alien that could live there. I know that the kids had a great time putting what they learned into a fun, creative, and meaningful lesson.
Caring

I have heard this quote on more than one occasion and I find that it fits my experience. “They will never care how much you know until they know how much you care.” What a powerful statement! I believe that is an accurate statement. Is it possible that some part of my problems back in the early days of my teaching was due to my lack of caring? One needs to think for just a moment. Some students spend more time with their teachers than they do their own parents. This means that lives are being shared. All that time gives teachers a golden opportunity to reach out and let students know that they too are human. Teachers can laugh, smile, and tell a joke when appropriate. In my experience, when I take the time to step into my students’ world, my efforts are rewarded more often. That means teachers, like myself, must expend time and energy to listen to the things that make the students’ happy, sad, angry, excited, anxious. This aids me as the teacher of middle school students because this is their life; stories about their triumphs and tragedies. If a teacher takes the time to know how that student did on their soccer game yesterday, then that student will take the time to learn and make sense of things within the format that the teacher designs.

Effective teachers care about their students and demonstrate that they care in such a way that their students are aware of it. . . .One study defines caring as an act of bringing out the best in student through affirmation and encouragement. Obviously, the characteristics of caring go well beyond knowing the students to include qualities such as patience, trust, honesty, and courage. Specific teacher attributes that show caring include listening, gentleness, understanding, knowledge of students as individuals, warmth, and encouragement, and an overall love for children. (Stronge, 2002)
Another method of showing care, a teacher should demonstrate that learning is worthwhile. Students should see that the teacher cares about their learning. How does a teacher go about doing this? I have found that asking questions about what they are learning makes that difference. Making sure that everything that occurs in that science classroom is meaningful shows the students that the teacher cares. I recall classes in my past for which I did not care because I sensed that the teacher did not care. It was just a job to that person. I never went above and beyond in those kinds of classes. However, when I knew that the teacher was organized and asked if I had been doing my homework, that showed me that the quality of care was evident in that teacher. The teachers that care are the ones that stand out clearly in one’s mind. The special people mentioned in my educational autobiography are noted because they were effective as teachers; they cared. One student states that I do have this quality. “My science teacher is a teacher that cares about what his kids learn about.” Another student shares, “He explains very clearly and wow he is so nice. When I need help, he is there for me.”

Competent

When I think about this quality, I think to myself, “Does this teacher know what he or she is talking about?” But it is more than that just knowing or understanding. An effective teacher has sufficient content knowledge but also needs to have sufficient pedagogical knowledge as well. In other words, I, as the educator, need to know about my subject and I need to know how to teach. I have had experiences with both types of teachers. It is a very painful time when you have a teacher with content knowledge or pedagogical knowledge but not both. Effective teachers, according to research, need both kinds of knowledge.
Strong teacher content knowledge alone does not change student knowledge. On the other hand, use of effective pedagogical methods without adequate content knowledge does not improve student achievement substantially, and in some cases may actually reinforce student misconceptions. As teachers’ pedagogical content knowledge increases within the context of a strong knowledge of content, their ability to impact student learning also increases. (2001)

In my college Pre-calculus class, I have no doubt that the mathematics professor “knew his stuff” about math. Unfortunately for me, his pedagogical knowledge was lacking. He was working under a positivist approach and did not make an environment that was conducive to learning. On the other hand, Paul Cottle was a teacher who was competent in his content and pedagogical knowledge which is why I think differently about electricity, sound, and moving bodies. Cottle was an effective teacher because he “knew his stuff” about physics and understood how to teach so that I benefited. He, as the teacher, comprehended that teaching involves many aspects. Things like class arrangement, questioning skills, inquiry-based activities, and critical thinking were just some of the methods used to create a place where learning could take place on a regular basis.

Remaining competent, that takes work on the part of the teacher. This means that the teacher never has to lose touch with being a learner. Learning should be a lifelong affair in the life of a teacher. This means that workshops, inservices, college courses, reading educational journals, and wondering about things they teach should be integral parts of a teacher’s daily life. How else can a teacher remain competent unless he or she continues learning about their subject area (content knowledge) and continue learning about teaching (pedagogical knowledge)? I have been evidencing this quality in that I have taken part in summer workshops improving my
pedagogical and content knowledge. The experience of reading all the research pertaining to my research question keeps me competent and headed in the direction of teacher effectiveness.

Another practice that keeps me competent is reflecting back and asking myself, “What can I change to make it better?” By doing this, my practice of teaching improves substantially. However, I also practice what Schon (1987) calls “reflection-in-action.”

. . .we may reflect in the midst of action without interrupting it. In an action-present-a period of time, variable with the context, during which we can still make a difference to the situation at hand-our thinking serves to reshape what we are doing while we are doing it. I shall say, in cases like this, that we reflect-in-action. [p. 26]

This happens to me during class numerous times as we discuss various concepts. I will “change gears” because I notice that they are getting fidgety. So, I will change the plan “on the fly” so that I protect the learning environment and keep it secure from unnecessary distractions or disruptions. If I were reviewing some homework questions, and I notice that attention is lagging, I will begin walking around the class. Getting the students to learn the rules of the class takes time. Doesn’t everything? As they learn the protocol, learning happens more often. I have to aware and sensitive to changes in the learning environment. I would think of it as tending a valuable flower. The gardener has to make sure that the orchid has all the water, sun, soil, etc. that it needs. If it gets too windy, then the plant is taken to a safer spot. Teaching is like keeping the flower alive and well by being vigilant and attentive to every need, known or unknown. If the need is unknown, it is my job to find out what it is that is needed so that the learning environment continues to flourish.
Committed

Teachers, especially effective ones, “stick it out.” Teaching has its highs and lows. There are days that I have felt that I could teach forever. My students were responding to the questions I was asking. The laboratories that I designed for them to make sense of some scientific phenomena were accomplishing their purpose. Those are the days that I love.

Other days, I have wanted to quit and go back to bed. Frustration, exasperation, anger, disappointment, and sometimes even betrayal are feelings that bubble to the surface when the day is “headed down the drain.” Amidst these feelings, this teacher has “hung-in” there despite all the challenges that have presented themselves on a daily basis.

Teachers are committed to their students and their learning. I believe that all students can learn. I just have to find the right angle to get that disinterested student interested and engaged. I had one student who had it in her mind that my class was the perfect time for a nap, despite the fact that there were hands-on laboratories that utilized critical thinking. That day, the students were to determine the density of various unknown metals. Materials at their disposal consisted of a triple beam balance, ruler, and a graduated cylinder. They had to work in groups of three and figure out the density of each. We had already discussed the concept for a couple of classes. Once the densities were determined, a list showing the various densities of metals would be given. They would then use it to determine what kind of metals they had. I walked over to her and started talking. “What is the problem? Are you okay?” I asked. She responded, “I stayed up late last night and I am really tired.” “Oh, well, how are you doing with your work?” “I don’t get it. This doesn’t make sense.” “Show me what
your group has done” I tell her. She pulls out the journal. There is some write on it but I can tell she hasn’t done too much.

I keep working with her. “What doesn’t make sense?” “I don’t get the density. What is that?” she asked. “What properties are associated with density? Check with your team,” I reply. Five to ten minutes later, I see that she is more involved. “How is it going?” She answers that she thinks that one is aluminum. “How do you know?” I hand her the block of lead. “What is the difference between this cube and the one you’ve labeled aluminum?” I ask. She replies, “It feels heavier.” “What do you mean?” I inquire. She begins, “It has more weight.” One of her teammates says, “It has more mass.” I ask, “Which one is it? Find out.”

This little episode shows that I am committed to my students. I want them to succeed and learn in my class because they are thinking for themselves. That student now is accustoming herself to the science environment and now participates and adds value to the collective discussions in class. She is now thinking for herself and learning is taking place.

. . . a dual commitment to student learning and to personal learning has been found repeatedly in effective teachers. A common belief among effective teachers, which reveals their dual commitment, is that it is up to them to provide a multitude of tactics to reach students. In essence, effective teachers view themselves as responsible for the success of their students.
(Stronge, 2002)

I am also committed to continuously learning. I have kept my certifications current. I will model to my students what I want to see in them. A love of learning is evident in my personal life. As students ask their questions, I will ask questions solely to hear their ideas on it. Recently,
in my honors class, we were reviewing the previous night’s homework assignment. It had to do with temperature inversions. The question asked, “Which of the two places would experience a problem with air pollution due to its location: a city in the Great Plains or another in the Rocky Mountains?” We discussed it and drew a diagram of both cities incorporating the idea of temperature inversions. As we continued talking about it, I looked at the diagram, and said, “This does not make sense.” The diagram had cold air on top of the warm air and from what I have learned, cold air is more dense than warm air. It didn’t fit with what I knew. Unfortunately, time is a constant constraint in class. A definitive answer was never given. I read the book and still it makes no sense to me. I told the students “I will look into it.” I will. I want to know. I am committed to my learning as well as my students’ learning.

I don’t want to make it seem that all students thought I am the best teacher that has walked the earth. As a matter of fact, some were brutally honest and have brought some issues to my attention. For example, although I am a competent science teacher and “know my stuff”, there are many ideas that they are responsible to know. One student shares his frustration. “My science teacher explains the lessons, but sometimes goes a little too fast. When students ask questions, he answers them in a way I understand, but sometimes I don’t understand because he explains in a way I don’t understand.” Another student agrees. “Slow down a little and more videos.” One more student echoes the same idea. “My science teacher helps a lot but he goes too fast. Like one we’re in something then the next day we’re in another subject.”

One student felt very comfortable by stating “My teacher can explain a little better, use humor, and use examples more often.” Another
comfortable and open student cuts to the chase, “He could improve how he explains because he’s boring.” Other students requested less homework, projects, and tests. “Sometimes giving quizzes and test all the time doesn’t help our learning.” Despite some unhappy students, I would say that most would be pleased with the science class that they experienced.

Summary

I am on the road to teacher effectiveness because through my practice these five qualities are evident: care, confidence, concern, creativity, and commitment. I care about my students because I am involved in their lives and am concerned about their learning. I am myself when I am with them and have a good rapport with them. I am confident in their abilities and in my own. This is why the class is designed around “hands-on” laboratories and inquiry. I am creative. I am not constrained to the lesson plan. I follow the learning and try to involve my students in the process. I am competent. I keep building my content and pedagogical knowledge so that my students are the beneficiaries of all my work. I am committed to the profession of teaching and to the learning of my students. I model a love of learning so that my students will “catch it” too. I am not one hundred percent effective, who is? However, day by day, I am becoming more effective as a science teacher.
REFERENCES


Bulger, S. M., Mohr, D. J., & Walls, R.T. (2004). *Stack the deck in favor of your students by using the four aces of effective teaching.* Retrieved on October 21, 2004 from www.ucw.edu/cte/et/articles/bulger


I was born in Chicago, Illinois on August 26, 1973. I attended Florida State University and earned a B.S. in Elementary Education. I currently teach eighth grade science at Redland Middle School in Miami, Florida.