

AN ARTS-BASED NARRATIVE INQUIRY INTO CO-PLANNING AND TEACHING
ELEMENTARY SCIENCE USING THE VISUAL ARTS

by

JAMES B. CALKIN

(Under the Direction of Deborah J. Tippins)

ABSTRACT

Educational researchers are frequently called upon as “experts” to improve instruction in school-university partnerships. With new methodologies and more hands-on approaches, researchers are able to co-teach with classroom teachers. At the same time that classroom teachers are asked to collaborate and teach in new and meaningful ways, they are under increasing pressure to improve students’ test scores. This study took place in the context of a fifth grade classroom in one such university-school partnership, in which a university researcher collaborated with a classroom teacher to explore what happened when they developed and implemented arts-based science units. The research focused on teacher-learning as they co-planned and co-taught three units which centered on the use of drawing and painting to teach science. As a culminating activity following instructional units on oceanography and landforms, student and researcher artwork was displayed in an exhibition at a nearby university. An opening reception allowed students to share their work with parents, teachers, and university partners. Using arts-based narrative methods, data collected included daily audiotaped conversational interviews and teaching interactions; sketch, dialog, and audio journals; student and researcher artwork; digital photos; and archival data. Specific findings were drawn from

narrative analysis (writing stories) and analysis of narratives (coding texts and generating tensions) to construct schematic narrative templates. The findings are presented as teacher cases and touchstone narratives which incorporate tensions such as “less is more,” the connections and disconnects in teaching science using art, and shifting roles as we searched for the best ways to teach students. Three schematic narrative templates which comprise the second part of the findings were constructed through a theoretical lens which compared Dewey with Vygotsky while applying ‘art experiences’ to science education. The templates are underlying claims and tensions that explain much about the way the specific narratives were told and the research experienced. They include differing views of science, contrasting researcher epistemologies (consistent with Vygotsky’s and Dewey’s), and collaborating and co-teaching successfully within the context of these differences. Conclusions are drawn from educational literature and implications are described for university researchers, science teacher educators and elementary science teachers.

INDEX WORDS: teacher learning, interdisciplinary, visual arts, science, arts-based, narrative, elementary, collaboration, co-teaching, partnership, art experiences, and drawing.

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JAMES B. CALKIN

MS, North Carolina State University, 1998

A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial
Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2005

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JAMES B. CALKIN

Major Professor: Deborah J. Tippins

Committee: Betty Bisblinghoff
David F. Jackson
P. Elizabeth Pate

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
May 2005

DEDICATION

To my father, Ken Calkin, and my son, Abraham.

ACKNOWLEDGEMENTS

For someone who claims to thrive on collaboration, the dissertation process was, at times, an especially lonely one for me. Even so, I managed to drag many people into it and I am most grateful for those numerous and often selfless contributions. In particular, I want to thank my committee members Betty Bisblinghoff, David Jackson, and Elizabeth Pate. At those all important committee meetings as well when we met individually, each member, in their own way, helped me immensely. In addition, professors Pam Taylor, Norm Thomson, Malcolm Butler, and Carolyn Wallace added valuable feedback and support.

I am grateful to all the fifth grade students that I was privileged to work with as a part of this study. I want to thank Jim Randolph and Bob Hart for their invaluable help in making the exhibition successful. In terms of writing, Jo Beth Allen, Karen Hankins, Kakali Bhattacharya, and Alexa Darby were wonderful to me. Laurie Varner, Robbie Quinn, and Stephanie Rubanowice helped immensely as well.

My Dad, Ken Calkin, was perhaps the most enduring source of inspiration, having not only encouraged my entry into the doctorate process, but also emphatically pushing for successful completion. I have always been incredibly proud of him. In addition, one of the many things he taught me (by example mostly) is the value of listening to wise women around me.

To my Mom, Judy Calkin, who taught me so much about people, myself, and also the value of listening to wise women.

To Violet Calkin, who at times has distracted me, but most importantly has made me want to finish so my full attention and appreciation can return to the best toddler I know (a future strong woman herself).

To Katie Calkin, who has been so amazing to me through this process while at the same time keeping me grounded in the truly important things. In the five years since starting my doctorate program, we have grown so much together and as individuals.

To Annette Santana, who asked for so little but gave so much, not just to me, but more importantly to all her students. To me, few people do so much to make the world a better place.

To my advisor, Deborah Tippins, who asked so much of me in the right ways and was always willingly to give immense amounts of time to insure that I progressed. I am most grateful for her wisdom, support and commitment to my success as in this process.

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CHAPTER ONE
INTRODUCTION AND RATIONALE



Figure 1.1. Danny's drawings of three ocean animals done during one of our science and art activities, 10/2003.

"My art teacher Jamie taught me how to paint. He also taught me how to draw landforms. My other teacher taught me how erosion works." (Excerpt from Danny's 'Bio,' 1/2004).

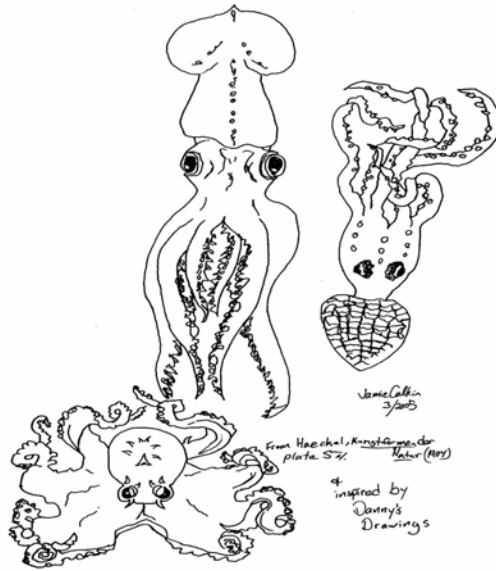


Figure 1.2 My drawings of three related ocean animals (octopi/squid) inspired by Danny's and copied from Haeckel (1974, plate 54).

While SEEING/DRAWING I glimpse into Nature,

I taste Nature, the Nature of Reality:

THE WAY OF SEEING IS A WAY OF KNOWING!

(From the Zen of Seeing: SEEING/DRAWING as Meditation, Franck (1973), p. 130,

Capitol letters by author)

From personal experience and the impressions recorded by others, let me offer the following rough map of innovation in science. You start by loving a subject. Birds, probability theory, explosives, stars, differential equations, storm fronts, sign language, swallowtail butterflies—the odds are that the obsession will have begun in childhood. (E. O. Wilson, 1984, p. 64).

Introduction

My own obsession with science and nature began when I was a child. However, that love had almost ceased to exist by my fifth year of teaching high school science. Since then, I have

found a renewed love for natural things...through drawing and painting them. Danny's drawings and quote (Figure 1.1) inspired me to draw other sea animals (Figure 1.2) from Ernest Haeckel's plate 54 in *Artforms in Nature*. This study represents my efforts to merge art and teaching science.

Before turning to the literature, I share a little more about what specifically led me to this study. At first, my work as an emerging 'local artist' was completely separate from my efforts as a Ph.D. student in science education. But when my artwork and graduate work started competing for my time and energy, I naturally sought ways to connect them and received support from my colleagues in this search. It soon became clear that I had found many more connections than were possible to study at once. For example, art could be used as a tool to bridge cultures and languages, and I quickly learned that art could inform my work in science education. Elliot Eisner (2002), who himself has made a bridge between his work as an educational researcher and as a painter, states:

Another lesson that education can learn from the arts is the way something is formed matters. We tend in our culture to differentiate between content and form. *What* is said, for example, is believed to constitute content. *How* it is said is believed to constitute form. It's all very tidy (p. 197).

Conversely, connecting form and content can be messy. Even so, it was important to me that this study is about explore connections between form and content; specifically connections between art and science (content) and art to teach science (form).

In this first chapter, I provide a rationale for using drawing and painting to teach science by exploring the larger picture of how scholars from art, science, and education have described interconnections between their often distinct fields.

Art and Science: Worlds apart or parts of the same world?

Over the years, many scholars and practitioners have sought to define and describe the connections between art and science. Below, I provide select contributions from the following groups as a rationale for using the visual arts to teach science: scientists and artists, historians and philosophers, educational psychologists and theorists, art educators, and science educators.

Connections to art by scientists and historians of science

According to Girod (2001), there has been renewed interest among scholars in the connections between art and science. In the introductory chapter of his unpublished dissertation, a convincing argument is provided for using aesthetics to understand and teach science. I return to his work later below.

Scientists and historians of science have taken diverse stances on the relationship between art and science. Some believe science should remain distinct from other disciplines or forms of inquiry and efforts to blur the boundaries are counterproductive. C. P. Snow, in his lecture and subsequent book *The Two Cultures and the Scientific Revolution* (1959), made the argument for drawing stark boundaries between science and what he referred to as the social sciences, including the arts. Thomas Kuhn (1969), while less adamant about the distinctions between artists and scientists created by what he calls the two-culture problem, nonetheless sought to define key differences between the two in his article “Comment on the relations of science and art.” In it, he writes, “if careful analysis makes art and science seem so implausibly alike, that may be due less to their intrinsic similarity than to the failure of the tools we use for close scrutiny” (p. 404).

Kuhn (1977) uses his historical knowledge as one of the tools to illustrate dissimilarities between art and science. For example, he notes that many scientists from the past, “like Galileo

and Newton, whatever their genius, were wrong, made a mistake” (p. 346). Comparing this issue (of wrongness and mistakes) to the paintings of Rembrandt, Kuhn poses the following question (which I paraphrase here): if art works are still considered living even if his school of art or tradition is dead, what takes the place of right/wrong or correct/incorrect that exist so clearly when viewing the works of scientists past? In other words, Kuhn uses historical cases to illustrate that science can be judged as correct or incorrect, but art cannot.

More recently however, numerous scientists have written with exuberance concerning the value of exploring the connections between art and science. In E.O. Wilson’s (1984) Pulitzer Prize winning book *Biophilia*, he tells many stories detailing his wonder at the relations between the work of scientists and artists. The central theme of his book is the connectiveness of humans to other living things. He calls for greater environmental awareness and ecological conservation.

We are in the fullest sense a biological species and we’ll find little ultimate meaning apart from the remainder of life. The fiery circle of disciplines will be closed if science looks at the inward journal of the artist’s mind, making art and culture objects of study in the biological mode, and if the artists and critic are informed of the workings of the mind and the natural world as illuminated by the scientific method. In principle at least, nothing can be denied to the humanities, nothing to science (Wilson, 1984, p. 81).

In another thought, he notes that the act of discovery is at the core of the work of both the artist and the scientist. He prefaced that commonality by citing one of the most prolific visual artists in history, “Picasso defined art as the lie that helps us to see the truth. The aphorism fits both art and science, since each in its own way seeks power through elegance” (Wilson, 1984, p. 63).

Also making the case for environmental conservation, *Essence of Place* (Odum & Odum, 2000), like *Biophilia*, is a unique book in the way it draws connections between art and science.

World renowned ecologist, Eugene Odum, wrote about ecology in what he calls “ecological message and/or an interesting anecdote” by describing the 62 landscape watercolors painted by his wife, Martha Odum.

Stephen Gould, another contemporary scientist and prolific author of books about science, has made some connections to visuals and specifically to scientific illustrations. “Primates are visual animals” he writes (Gould, 1987b, p. 18), noting the importance of scientific illustrations (1987a) and other images used in science. For example, Gould highlights pictorial summaries that represent metaphors and analogies (1987b) used not only in making sense of science ideas, but in communicating them to others.

In echoing Gould’s claims, Baigrie (1996), asserts pictures often do the “bulk of the scientific work” (p. xix). Specifically, he is comparing illustrations to photographs and especially verbal and oral language, which hold the privileged place in representing scientific knowledge. In the text, entitled *Picturing Knowledge: Historical and Philosophical Problems Concerning the Use of Art in Science*, the Baigrie and other contributors discuss numerous topics related to the contributions of drawings and illustrations, from anatomy in Renaissance science to how illustrations have been used to convey ideas about early hominids.

Connections to science by visual artists

Visual artists illustrated (and sometimes explicitly described) the many ways science connects with their work. I organize those connections into three sections: 1) specific topics such as anatomy and nature, 2) sharing the process of observation and drawing what you see, and 3) scientific illustration – a field described as ‘art in the service of science.’

Connections: the process of observation

Learning to draw helps students in learning to see (Nicolaïdes, 1941; Edwards, 1989, Franck, 1973). In a foundational book on drawing, Nicolaïdes (1941) asserts, “learning to draw is really a matter of learning to see – to see correctly – and that means a good deal more than merely looking with the eye” (p. 4).

Fredrick Franck (1973) concludes his handwritten and pen and ink illustrated book with the statement quoted at the beginning of this chapter about how important drawing can be. Seeing/drawing, according to Franck, is not only a way to represent natural objects, but also a way to experience our world with our senses and perceptions. While making no direct references to science(s), Franck offers a way of drawing akin to contour drawing (Nicolaïdes, 1941), and many more references to spirituality/religion than traditional notions of Western Science (Snow, 1959). Still, his book portrays a particularly convincing and attractive path towards nature study (Jackson, 1998).

Content connections: nature drawing and artistic anatomy

Like Franck, Nathan Cabot Hale (1994) draws from nature; but in doing so, makes direct comparisons of the relationship between art and science in his book *Abstraction in Art and Nature*. Specifically in relation to natural form, Hale describes his view (as an artist) on the difference between the two fields:

Like science, art also separates nature into categories of form. But these categories of art differ from those of science; they are less precise and less measured, or—as the scientists might put it—art is qualitative while science is quantitative. These two fields sometimes overlap and you will occasionally find a scientist who is very intuitive or an artist who has the ability for precise analysis. As a matter of fact, a good deal of what we know of

form today is the result of scientific study that has been re-examined with the artist's eye (p. 61).

While making some sweeping generalizations that concur with those of Snow's (1959) 'two-cultures,' Hale (1994) points to the important relationship of form in art, and science in understanding nature. Furthermore, the exercises and illustrations in his book, while more prescribed than Franck's, place one in an undisputable position to learn more about nature through art.

Moving from the topic of nature to one of human biology, Robert Beverly Hale (1964) decries the loss of knowledge and skills in what he describes as the field of artistic anatomy among Twentieth Century artists, at least when compared to Rembrandt, Degas, and many of the Renaissance masters. Simblet (2001) also uses the work of 'the great masters' to help artists render the human figure in accurate and aesthetic ways, and introduces her book *Anatomy for the Artist* with the intertwining of history, art, and science specific to humanities' understanding of our own bodies.

Scientific illustration: Art in the service of science

Perhaps the most direct connections between art and science are found within the realm of scientific illustration (Hodges, 2003; Baigrie, 1996; Hale, 1993; Herdeg, 1973). Hodges (2003) notes that scientific illustration is a field that is "...an ideal fusion of interests in art and science" (p. xi). She goes on to quote Goethe as claiming that the only way to really see a plant is to draw it. As a way of definition, Hodges offers a description of scientific illustrators as "artists in the service of science. They use scientifically informed observational, technical, and aesthetic skills to portray a subject accurately" (p. xi). Similarly, Herdeg (1973), edited a book entitled *The Artist in the Service of Science*. He put the role of teaching at the core of a scientific

illustrator's role, as his/her central job is to "create a three-dimensional entity which elucidates a scientific concept or facilitates the educational process" (p. 45) through close observation, knowledge, and skills in both arts and sciences.

It is the images in all the books mentioned in this section that hold the real power to build links between science and art. In limiting myself to words to try to describe that power, I cannot help but end this section with the following plea, 'Find these books and look at the pictures!'

Educational psychology and philosophy

Moving from the worlds of artists and scientists, I turn to that of educators. Educational psychologists and philosophers have contributed the most support for the connections between art and science.

Howard Gardner (1973), a prominent educational psychology researcher, noted "human creativity has numerous parallels across realms, with inspiration, intuition, and gestalt perception playing an indispensable role in the activities of both scientists and artists" (p. 318). In his first book, *The Arts and Human Development*, Gardner lays out arguments for how the work of artists and scientists are both similar and different. In doing so, one of Gardner's purposes was to argue that Piaget's sole emphasis on scientific development left out other factors, not the least of which was artistic development.

Perhaps more influential in supporting the connections between art and science is Gardner's book *Frames of Mind* (1983), that explains how the multiple intelligences include, but are not limited to, traditional quotients. Specifically, his notion of visual/spatial intelligence supports the claim that science has much to gain from connections with visual arts. Recognizing and classifying patterns and organisms in the natural environment is included as an additional intelligence which Gardner (1999) describes as naturalistic intelligence. The processes of

drawing from life and in nature are invariably linked to these intelligences (Leslie, 1994; Franck, 1973).

Dewey, in *Art as Experience* (1934), describes connections between art and science in terms of the ways humans interact with, and make sense of, their environment. For example, Dewey claims the study of rhythms in nature is what drove progress in the natural sciences and has always been central to the arts. As human understandings of natural rhythms expanded, Dewey (1934) writes, “the development reached a point where the scientific and artistic parted ways” (p 149-150). While the arts still depended on a more visceral understanding of natural change and rhythms, according to Dewey,

...the rhythms which physical science celebrates are obvious only to thought, not to perception in immediate experience. They are presented in symbols which signify nothing in sense-perception. They make natural rhythms manifest only to those who have undergone long and severe discipline (p. 150).

However, Dewey holds out hope that science and art can one day reunite in their celebration and understanding as he continues, “yet a common interest in rhythm is still the tie which holds science and art in kinship” (p. 150). For example, the stuff of poetry, that of “enjoyed perception” (p.150) can be derived directly from the work of scientists and not just by those trained in science.

One notable application of Dewey’s work in connecting art and science that spans the various fields of education is Lawrence-Lightfoot’s book, *The Art and Science of Portraiture* (1997). Most of her claims concerning Dewey relate to educational research. However, Lawrence-Lightfoot also promotes Dewey’s notions as important to teaching students by helping them connect and use both science and art to make sense of experience.

Art education – connections to science

MacGregor (1995) theorizes that science can be viewed as ‘life as lived’ while art viewed as ‘life as invented.’ While acknowledging this as an arbitrary distinction, MacGregor places science on one side of the continuum as factual and art on the other side as constructed. He then looks at places in the continuum where lived and invented meet – and describes one such place in the work of Ernest Haeckel, from 19th century Germany. Haeckel’s efforts to share the beauty of nature with a wide audience led to the publication of *Kunstformen der Natur* in 1904. *Artforms in Nature* (1974) was republished for a larger audience without the text, except captions with revised nomenclature/classification. His lithographs of radiolarians (tiny sea creatures) are used as an example of the middle ground. MacGregor asks, “are Haeckel’s drawings works of art or scientific records?”

Creativity in art and science

Numerous scholars (Gardner, 1973; Innamorato, 1998; Yeomans, 1996) make connections between art and science in terms of creativity. Yeomans (1996) characterizes creativity as connecting things not before connected to generate new and original constructs. These could include ideas and processes in art and science, for example.

Eisner (2002) and Efland (2002), both prominent art educators specializing in the visual arts, claim that the arts has much more to teach k-12 students than their marginalized status as an elective or ‘special’ imply. They argue for the arts to be included in core curricula, instead of on the fringes. For example, artistic use of metaphors can have great power in teaching students science according to Efland (2002), who draws mostly from work in cognition. Eisner (2002) roots many of his art-as-education arguments on the work of philosophers like John Dewey and Susanne Langer.

Connections between Science and art (from a science education perspective)

The arts, and specifically the visual arts, have not been at the root of very many empirical studies in this line of science education research. To support this claim, I turn again to Girod (2001) who found the same result to be true after his extensive literature search (also rooted in science education). He wrote, “the notion of the connection between art and science is not new....however...conversations on the connection of art and science have not found significant voice in the science education community” (p. 2). Specifically, he claims to find no empirical research that integrates aesthetics into the teaching/learning of science (aesthetics is discussed below).

In terms of visual arts in science education research, its use has been focused (and quantified) to such a degree that the conclusions have little to say about the process of using the visual arts to teach science. For example, students’ drawings have been used as an assessment tool in the Draw-a-Scientist research (Finson, 2002; Newton, 1998, Van Zee & Roberts, 2001), as an assessment tool in biology (Wandersee, 2000), and in studies comparing students’ drawings of science diagrams vs. writing/looking at text diagrams (Gobert & Clement, 1999). Practitioner-oriented journals often decry the value of integrating art into science classrooms (eg. NSTA, 2005). Even so, my search specific to visual arts has yielded the same result as Girod’s search for aesthetics in science education, with one notable exception: the work of Karen Gallas.

From the arena of elementary teacher-research, Gallas (1991, 1994, & 1995) describes in detail her elementary teaching experiences in using art and other forms of expression to help students learn all subjects, including science. Gallas (1994) claims that teachers need to help their students expand their repertoire of languages, including art-making (which she defines as both a language and an epistemology). For example, she describes how her first and second

graders used drawing as both a sense-making and an assessment tool after each Science Talk (1995). In greater detail in Chapter Two, I discuss her work and other elementary teacher-researchers who contribute to the anecdotal (if not empirical) evidence supporting the argument for the value of connecting art and science (Ernst, 1994, 1997; Whitin & Whitin, 1997).

Aesthetics in science education

Aesthetics or the study/philosophy of beauty and art (Flannery, 1991), has been included as important to science education in position papers (Flannery, 1991; Brady & Kumar, 2000) and most recently in the empirical work of Mark Girod and colleagues (Girod & Wong, 2002; Girod, Rau, & Schepige, 2003).

Flannery (1991) and Brady and Kumar (2000) both call for science educators to learn from aesthetics to make their teaching more accessible to students. Flannery claims more attention to aesthetics would have three main benefits: 1) better student attitudes, 2) a more appropriate view of the process of scientific inquiry, and 3) better science teaching in general. In his concluding statement, Flannery (1991) makes a convincing case:

Including the aesthetic dimension could change science courses both globally with focus on aesthetics themes: order, rhythm, form, etc., and specifically in the way lessons are taught: more emphasis on the visual, more attention to affect, more emphasis on the aesthetic qualities of science's processes and products. With such changes, science courses could truly become beautiful experiences for students (p. 591).

Brady and Kumar (2000) build on many of Flannery's assertions, specifically in the methods in which science is communicated to wider audiences, especially in the interest of 'science for all'. They also provide some poignant examples, like their discussion of Leonardo da Vinci, who according to the authors, saw no distinction between art and science; in fact, he

believed they complemented each other directly, as a perusal of his sketchbooks demonstrate (for example, see Kemp, 1981).

In a series of articles and works that include his dissertation, Girod (2001) combines Dewey's notions of art experience into an approach to teaching science for aesthetic understanding. While he notes that he did engage his students with examples of art, he does not explicitly discuss connections between art teaching (or specifically the visual arts) with science learning. His approach is centered on using metaphor and possibilities to explore science ideas and link students' creative stories and questions to canonical science ideas.

Clearly there are many possibilities and potential values in connecting art to science. Artists, scientists, and educators all have touted this notion. The next step is to explore how to actually apply these ideas in the classroom. Before I review the educational literature (in Chapter Two) specific to teachers using the visual arts to teach science, I describe my research purpose and guiding questions. Before doing so, however, I have to return to the issue of form and content.

A brief note about form/content related to teacher collaboration

It is Eisner's (2002) belief that, at least in education, form and content are invariably connected. Girod (2001) explores the question of the content of science by teaching for aesthetic understanding (the form) as the sole instructor. That is, he was *the* science teacher for a group of students in which he explored form and content. Like me, at the time of Girod's study, he was not a classroom teacher. However, he knew a fifth grade teacher that would let him be *the* science teacher. I sought to do the same, to do it alone; that is, to 'borrow' a group of students to explore how I could best teach science (content) using the visual arts (form). Unlike Girod, however, I had little experience working in an elementary classroom. Indeed, after teaching for

three weeks (Unit One), I found I needed to work closely with the classroom teacher to succeed in teaching science using art (to her students). The form of my teaching experience, and the goals of my study, changed – what I had originally imagined as primarily a “self-study,” quickly shifted to more emphasis on collaboration. I needed to collaborate with the classroom teacher and that would alter the ways in which the students learned science. If I still wanted to explore form and content together, then my study had to change.

Adding collaboration to my study naturally complicated the issue of form and content. Furthermore, the dissertation process itself overly separates content from form (Eisner, 1991). Despite the difficulties, I added this additional layer to the scope of my study; that is, I sought connections between collaborating (coplanning and coteaching – the form) and how two teachers cotaught science using visual arts (the content).

Purpose of the study and guiding questions

The purpose of this study was to explore how the researcher-teacher and the classroom teacher collaborated to develop and implement science units using the visual arts. Research focused on how the relationship between the researcher and the classroom teacher evolved over the course of the partnership, and the type of learning about teaching that occurred in the interactions between the two participants.

Specifically, the guiding questions (and subquestions a-d) in this study were:

1. What facilitates and constrains the development and implementation of units centered on the visual arts to teach and learn science?
 - a. How do I conceptualize the relationship between curriculum and teaching?
 - b. How does this change throughout the course of the study (if any)?
2. How do teachers collaborate to plan and implement arts-based science units?

- c. How do my perceptions and experiences of the planning and teaching of science units compare with those of the classroom teacher and students?
- d. What facilitates and constrains the collaboration to plan and implement arts-based science units?

Overview of the theoretical and methodological frameworks of the study

The theoretical framework of the study is based on a comparison of the epistemological differences between John Dewey and L.S. Vygotsky (Glassman, 2001; Girod & Wong, 2001). Dewey takes a bottom-up approach to student driven learning, whereas Vygotsky espouses top-down, teacher driven methods. These epistemological differences were important in the co-planning and co-teaching between the researcher and classroom teacher in the study.

The methodological framework of the study is arts-based narrative inquiry. This framework draws upon arts-based education research (Barone & Eisner, 1997), and narrative research (Wertsch, 2002; Polkinghorne, 1995; Clandinin & Connelly, 2000). Data collection included daily audiotaped conversational interviews and teaching interactions; sketch, dialog, and audio journals; student and researcher artwork; and digital photos. Specific narratives and narrative templates were used for data analysis. The specific narratives include two touchstone events and four cases.

Summary and Preview

This chapter has provided the rationale for connecting art and science, as well as my research purpose, guiding questions, and a brief overview of the methodological and theoretical framework informing the study. In Chapter Two, I summarize what the educational literature contributes to the two main layers of my exploration into form and content: 1) using visual arts

to teach science, and 2) collaboration and co-teaching between a university researcher and a classroom teacher. Chapter Two also includes a discussion of my theoretical framework. Chapter Three describes the methods of data collection and analysis, as well as a description of the participants and context of the study. In the first of two findings sections, Chapter Four contains specific narratives in the form of touchstone narratives and teacher cases. In the second part of the findings, Chapter Five highlights the three schematic narrative templates that I constructed to account for the underpinnings of the specific narratives. I end with a summary of the conclusions and implications for research and practice in Chapter Six. My personal biases and subjectivities have an influence across all of the chapters that comprise my dissertation, and are discussed in detail in Chapter Three.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Introduction

In this chapter, I examine relevant literature followed by a summary of the theoretical framework that informed the methodological framework and analysis of this study. Initially, I discuss definitions of collaboration starting with school wide collaborations, and briefly describe related models that include multiple classrooms. I mostly examine research on partnerships (a word I use interchangeably with collaborations) between individuals in single classroom research.

The second part of this literature review outlines studies that inform the use of the visual arts to teach science. Definitions of interdisciplinary curriculum and related models are considered, especially those from the literature that pertain directly to science and elementary education. I also examine studies specifically related to drawing and painting to teach elementary science.

The second part of Chapter Two highlights research that informs my theoretical framework, including a comparison of John Dewey and L. S. Vygotsky's ideas of the roles of students and teachers in the learning process. I focus on Glassman's (2001) comparison and Girod's (2001) use of Dewey's theories on teaching and learning specific to science education (teaching science for aesthetic understanding). These are contrasted to models closer to Vygotsky (conceptual change and discourse-based approaches to teaching science).

Review of relevant literature

Collaborations in Teaching

In theory, it makes sense; in practice, like new roses, it sometimes results in more thorns than flowers (Wasley, King, and Louth, 1995, p.205).

The flowers and thorns referred to above, according to the authors, are characteristic of collaborative inquiries between schools and universities. In this section, I discuss research on collaboration that includes theory, practice, and their intersections. Wasley, King, and Louth (1995) caution investigators and educators not to overlook the complexities of collaborations. In the above quote, they eloquently set the stage for my discussion of the educational research in this field of endeavor.

I begin this review with a discussion of collaboration models and suggestions in the literature (Goodlad, 1988; Hayes & Kelley, 2000; Hargreaves, et al., 2001; Cole & Knowles, 2000). This will be done by looking at roles and goals associated with various models, the places of conflict and differences in collaborations, issues of power in school-university collaborations, and models that range in scale from whole schools to individuals in classrooms.

The nature of collaboration: Roles and Goals...Egalitarian or dialectical

Numerous scholars offer their own definitions of collaboration (Goodlad, 1998; Snider, 1993; Cole & Knowles, 2000). The different interpretations of collaboration have features in common: for example, the partners share common goals and work together to achieve those goals. A key factor between various notions of collaboration involves the degree of difference among the roles these partners share and the various self-interests at stake in the partnerships.

In his chapter entitled “School-University partnerships: Rationale and concepts” John Goodlad (1988) explains his view of collaboration using a metaphor from the study of biology – symbiosis. Using the word partnerships interchangeably, he notes:

...the partnerships being entered into are symbiotic in nature—that is, two different kinds of organisms (institutions) are joining for the satisfaction of mutual self-interests. The obvious differences between schools and universities, which undeniably complicate and frustrate collaboration, are strengths, not weakness to be overcome” (p. 23-24).

Goodlad stipulates that for the group effort to thrive, each party’s self-interests must be met. He notes that those within the partnership should naturally work towards their own goals while doing what is possible to see that the goals of their collaborators are met as well. In the example of a mutualistic symbiotic relationship of lichens, the fungus needs chemical energy from the algae it houses (provided through photosynthesis). In the same way, the best location to reap the sun’s energy by the algae means the fungal substrate has ‘self-interests’ in providing the best spot in which to do that, thus meeting the needs of its algal partner. Looking at ‘intentions’ in metaphors, such as symbiosis, can be helpful in guiding educators to investigate and improve their own practice (Tobin & Tippins, 1996). Visual metaphors can be used in this manner as well (Lawrence-Lightfoot & Davis, 1997).

In the literature, collaboration is generally distinguished from cooperation in school-university partnerships (Hord, 1986; Cole, Knowles, Henson, Koivu-Rybicki, Madigan & Muchmore, 2000; Roth, Lawless & Tobin, 2000; Tobin, Roth & Zimmerman, 2001). According to Hord (1986), collaboration in school-university partnerships involves shared planning, implementation, and evaluation. It is like cooperation in that “some mutual agreement” (p. 22) is made, but whereas cooperation ends there, collaboration goes further. Cole and her collaborators

(2000) make a distinction between the two in terms of improving practice. According to these researchers, classroom teachers should ultimately improve their practice on the basis of their work with outside university researchers. Cole et al. (2000) are critical of the “scientific-inquiry model” (p. 173) that explicitly removes researchers from “reflexive and mutually beneficial roles.” Wolfe-Michael Roth, Ken Tobin, and their collaborators (Roth, Lawless & Tobin, 2000; Tobin, Roth & Zimmerman, 2001), explicitly blur the lines between teacher and researcher with what they call co-teaching and “co-generative dialogue” (a form of collaborative inquiry). From the perspective of their cogenerative model, all the adults in the room, whether they are university researchers, the classroom teacher, or preservice teachers (their research began as an alternative from of student teaching) constantly work towards facilitating student science learning.

Gehrke & Parker (1983) differentiate between egalitarian collaborations that involve communal effort in all aspects, and dialectical collaborations which recognize that partners work differently, depending on their individual needs and differences.

Differences between partners within collaborations

Differences between parties within collaborations were viewed by various scholars as a strength. Achinstein (2002) found conflict, or differences in ideology and orientations of change, could be productive when teachers were asked to collaborate within the context of school reform. Other researchers (Roth, Lawless & Tobin, 2000; Tobin, Roth & Zimmerman, 2001), view the differences between outsiders and classroom teachers in terms of their impact on each other and the students. They note that differences in collaboration can be described as tensions. Acknowledging that different partners come from different perspectives going in different

directions, they view this as appropriate. In fact, they emphasize that consensus is often not the goal, whether it is decisions within the partnership, or claims reported in research reports.

Cole and Knowles (2000) also recognize differences between classroom teachers and university educators; they claim the parties need to spend more time and energy explicitly finding shared responsibility in improving practice. These researchers are also critical of more scientific models of research where outsiders make efforts to keep their distance from impacting the classroom teachers and students.

MacGregor (1993) discusses difficulties within collaborative partnerships between schools and outsiders like universities. According to MacGregor (1993), “a collaborative partnership is one in which each of two or more parties contribute to, and receive benefits from an enterprise” (p. 4). Claiming collaborative partnerships are often discussed but rarely implemented, he cites difficulties within schools including little time and the need to find shared goals and negotiate roles. By extension, MacGregor emphasizes that issues of time and boundaries are exacerbated between outside partners and schools because of physical separation, issues of funding, and overall responsibility.

Snider (1993) offers several precepts for effective collaborative partnerships, including many specific to differences, that helped her within her own collaboration. As a narrative researcher, Snider integrates 11 themes into her story of a partnership between architects, artists, administrators, and art educators (of which she was one). The following of Snider’s 11 precepts are especially relevant to this study:

A. It is essential to be open to a variety of experiences (often outside one’s own discipline) and receptive to the possibility of encounters with “kindred spirits” in a variety of guises.

B. A respect for the other's point of view and a willingness to support it against opposition is critical to the process (p. 8).

Snider (1993) shares (consistent with the literature cited above), the value of differences as well as the explicit recognition of those features. A specific difference of critical importance to collaboration is discussed in the next section – power disparities.

Power disparities within collaborations between classroom teachers and university researchers

Reminiscent of the thorns among the new flowers, Hayes and Kelley (2000) note that university researchers with altruistic goals of entering into what they believe are collaborative relationships with teachers risk overlooking traditional power differentials that still exist between colleges of education and school teachers. Hayes and Kelley (2000) describe the pitfalls in believing collaborations between universities and schools are inherently egalitarian. Citing the traditional power differential between colleges of education and elementary schools, they claim that continuous and explicit negotiation of power should be at the core of these partnerships. The top-down nature of collaboration, including much specific to science education reform (Apple, 1989; Hart & Robottom, 1990; Barah & Luehman, 2003) makes collaborative relationships all the more difficult. Hayes and Kelley also describe the gender power differentials as well, noting that schools of education (which took the place of normal schools in the early 1900's) are often patriarchal, especially in working with female elementary teachers.

Hayes and Kelly (2000) claim that Hayes' biggest mistake was not explicitly talking about the power relationship. Hayes' believed that he had dispelled any power issues when he said he wanted to collaborate and work with the teachers. It is important to note that just the notion of researchers "helping" teachers is an issue of power.

Elementary school teachers often are not comfortable bridging theory and practice (praxis) – indeed, theory can override practical knowledge (imperial vs. local knowledges). Also, Hayes notes that he asserted himself as an expert, a power relationship that ultimately got in the way of true collaboration.

Roth, Tobin and colleagues (Roth, et al., 2002; Roth, Lawless & Tobin, 2000; Tobin, Roth & Zimmerman, 2001), found that power relations were often quite disparate between student teachers and university supervisors. This was compounded by the power differentials evident between student teachers and their mentor teachers. Roth, Tobin and their colleagues found that both relationships became more productive and collaborative when all partners co-taught together.

Models for university-school collaborations and differences in scale

Models that are especially relevant to elementary schools and/or science and art education collaborations between university researchers and classroom teachers encompass the majority of this review. Collaborations in the literature have also included participatory action research, particularly collaboration between classroom teacher-researchers (Gallas, 1994 & 1995; Cole, Knowles, De Sousa, Huebel, & Prendergast, 2000), and collaborations that focus on student teachers (preservice teachers) without explicit exploration into the relationship between the classroom teachers and the university researchers (Spellman, 2003). Other university-school collaborations not explored are enrichment programs (for example, afterschool activities) that do not include classroom components. Another form of collaboration that is not within the scope of this research involves entities larger than a school, for example, district wide, multiple schools, and state and national reform efforts between schools and universities.

Collaborations at a school level

Since this study focuses on one classroom collaboration between two teachers, I do not discuss large scale efforts of school reform (e.g. Slavin & Madden, 1995; Tippins, Wieseman, & Nichols, 1998). Instead, I begin with partnerships involving individual schools and universities (as this study was done at a site that fits that mold, see more on context of study in Chapter Three).

Comprehensive school reform (CSR) schools (Brandt, 2004) are places where the whole school is intended to be working collaboratively towards a common goal, often the goal of increasing student achievement. According to the National Clearinghouse for Comprehensive School Reform, CSR schools are products of collaborations between teachers and administrators, and often include university partners. The emphasis of change is on all teachers and for all students. However, teachers often isolate themselves more within their own classrooms when schools undergo these reforms (Brandt, 2004; Achinstein, 2002). In fact, Achinstein (2002) highlights how insider teachers view outsiders from universities in quite harsh terms and often retreat behind their classroom doors instead of participating in the collaboration. In the following quote, Brandt notes how isolation from partners occurred in one CSR school:

University and community partners often only pursued opportunities to work with the school when invited to do so. Thus, teachers perceived more work associated with coordinating times for university stakeholders to visit the classroom, organizing materials and planning for these visits, and later implementing new instructional practices after university stakeholders left. Given the current demands on their time, teachers felt as though they were being pulled in too many directions, which led select teachers to isolate

themselves from university and district support personnel and ultimately resist reforms (p. 249).

The issue of demands on teachers' time is frequently cited in the literature on collaborations. If partners perceive that extra time is needed without being given that time, shared benefits do not occur, as Brandt describes in a continuation from the quote above:

Although university and district partners found ways to communicate information, no time was left for teachers to reflect on and build a shared understanding about the Partnership vision and its implications for teachers' work. As a result, teachers perceived university resources as requiring additional work to utilize. Thus these resources failed to provide the strong assistance necessary for reform implementation (p. 249).

Collaboration, co-teaching and teacher learning in individual classrooms

Since this study is an exploration of the collaboration between two individual educators, the remainder of the literature reviewed relates to small-scale partnerships.

Between teacher-researchers (classroom teachers)

Teacher-researchers in the field of elementary art and science can collaborate with other classroom teachers to do research on their own teaching (Gallas, 1994, 1995; Ernst, 1994, 1997; Hubbard & Ernst, 1996). Karen Gallas explored her research questions and the data she collected as she taught in her own classroom with the help of a regional writing group composed of classroom action researchers. Teachers from her school also sat in and allowed her to do the same. However, she makes no reference to collaborating to co-teach in either of the texts describing her own classroom research.

Karen Ernst (1994 & 1996; Hubbard & Ernst, 1996), a former middle school language arts teacher, collaborated with classroom teachers at the elementary school where she became the

art teacher. Ernst (1996) led a summer seminar where she invited teachers and their classes to join her in the art room. They participated in a teacher-researcher group and published together. She tells the story of a team of teachers who worked together to infuse art into their curriculum through collaboration in teaching, learning about teaching, and working together to find and teach connections between art, writing, and science teaching/learning.

Collaborations and co-teaching between university researchers and classroom teachers

Numerous examples in the literature (Whitin and Whitin, 1997; Hayes & Kelley (2000); Roth (1998); Roth, Lawless & Tobin, 2000; Tobin, Roth & Zimmerman, 2001; Roth, et al., 2002) involve university partners collaborating with classroom teachers where they actually participated in teaching.

In an unusual and clearly productive collaboration, Whitin and Whitin (1997) wrote a book about their work with one class over the course of a year. In this study, Whitin was a professor of elementary education and his wife was a teacher-researcher in a new fourth grade classroom. While they allude to instances of co-teaching and co-researching, unfortunately, the Whitins did not explicitly discuss any specific inquiries into their own collaboration as part of the book. Following one of the few direct references to their collaboration, they note, “we are quick to admit that many of the events in this book would not have taken place in this way without those conditions” (p. ix). In an effort to address the concern of individual classroom teachers without university partners, they add, “...we are grateful for the opportunity to investigate the processes of inquiry so closely, and we are committed to find ways to create parallel conditions in different classroom situations” (p. ix). Details of their work related to interdisciplinary instruction are described further in a later section of this review.

In cases where the collaboration was part of the study focus, authors often found the partnerships to be positive when the classroom teacher co-taught with the university researcher (Roth, 1998, 2000; Fu & Shelton, 2002; Roth, Lawless & Tobin, 2000; Tobin, Roth & Zimmerman, 2001). In a collaboration between an elementary teacher and a teacher educator, Fu and Shelton (2002) tell the story of co-teaching a university class for preservice teachers. Shelton, the classroom teacher, noted feelings of intimidation in the early phases of the collaboration, but grew confident in her ability to contribute based on efforts by Fu, the professor, and the students' positive feedback.

Roth (et al., 2001) co-taught with several classroom teachers in one school and collaborated "under the auspices of professional development (p.188). The authors note that the lack of time for reflection and the inexperienced teachers' need for practical knowledge, point to co-teaching with experienced teachers as an effective way of learning teaching as a "craft" (p. 203). They criticize education programs that create in teachers the ability to "talk well *about* practice yet are unsuccessful *enacting* practice" (italics in quote, p. 203).

Acting as an outsider or non-participatory researcher, Roth (2002) also studied how two teachers co-taught, one a classroom teacher and the other a graduate student and part-time curriculum developer (who originally developed a unit on engineering). The co-planning and co-teaching allowed them to learn from each other while teaching "at each other's elbow" (p. 1), especially in terms of developing practical context-specific theories.

Roth teamed with Tobin in a series of studies where they co-taught with intern and supervising teachers in an urban high school (Roth, et al., 2002; Tobin, Roth, & Zimmerman, 2001). Besides co-teaching, they brought a research methodology known as co-generative dialogue to their work. In their studies, the student teachers, university professors, and classroom

supervising teachers all co-research as they work together to help the students learn science. Their research methodology is linked to teacher education; co-generative dialogue uses different qualitative methods to explore/make sense/theorize about teaching/learning in which all partners (including selected high school students) discuss the lesson directly after it is taught. In their studies, the university researchers explicitly enter into teaching/learning and work to share power. Their goal is to remove the gap between theory and practice; as part of that goal, theory comes after/as part of practice. The model of collaboration used by Roth, Tobin and colleagues differs from participatory action research which is usually done without co-teaching by the university partners. Instead, Roth, Lawless & Tobin claim:

...our approach is perhaps most akin to “practice research” (Nissen, 1998) as a specific form of action research in which the actual empirical projects are understood as joint ventures between research projects and various forms of quality development in practice (paragraph 8).

For example, Roth, et al. (2002) cite many examples where the collaborating teachers play off each other’s strengths, discussing these after each lesson.

University researchers who want to help classroom teachers: Failed collaborations.

In a collaboration perhaps closest in nature to my study, Hayes and Kelley (2000) tell the story of the power relationships between a university researcher and graduate student who volunteered as part-time science co-coordinators at an elementary school for two years. Told within the context of the historical relationship between universities and schools and power differentials, they relay many stories of Hayes’ failure to truly collaborate or co-teach with the teachers.

Even though he sought otherwise, he was often relegated to the powerless position of ‘guest instructor.’ In their collaboration, the teacher marginalized the power of the university expert, including what he asserted was the influence and power of theory. Hayes and Kelley describe an instance of how Piaget was cited to assert ideas for a lesson that in the end failed, as a result of the university collaborator’s lack of practical knowledge.

Collaborations involving teachers and other professionals are typically project oriented in nature, especially in terms of culminating events. Projects such as art exhibitions and research presentations reflect the many ways in which professionals provide valuable assistance in helping the teachers and students. Dori and Tal (2000) contrast these outcome-oriented partnerships with the out-of-context/lack-of-relevance often found with ‘one-shot’ guest speakers. For example, the “professional” collaborators provide support for preparation in exhibitions or events, (Clark & Zimmerman, 2000; Gainer & Child, 1986; Walker, 2000; Fannelli & Klippel, 2001). In a similar context, students could present their work to professionals who interact with them in evaluating the quality of the work (Dori and Tal, 2000). Uptis, et al. (2001) describe how professional artists can work with teachers to develop curricula that “incorporated performing and visual arts into the learning process” (p. 2) of math, science, history and other units. Artists also can work directly with the students having positive effects on students and teachers alike in terms of “a revitalization of teaching in other subject areas” (p. 2) and a commitment to more student art-making in their classrooms.

Scientists and artists (‘experts’) in classrooms (partnerships).

One model of collaboration found in the literature on partnerships is the kind established between classroom teachers and professionals that work in the subject area - in this case, scientists (Sussman, 1993; States, Brady & Sussman, 1993; Dori & Tal, 2000), artists (Uptis, et

al., 2000; Harvey, 2002), and scientific illustrators (Gainer & Child, 1986). These outsiders to public school classrooms are often not educational researchers or from colleges of education, but rather working professionals in the subject matter.

Curriculum/instructional models for teaching art and science

Educational literature is rich with definitions and categorizations of curricular/instructional boundary crossing, whereby teachers combine subjects or disciplines that are traditionally taught separately.

Pate (in press) defines the different curricular/instructional models and the boundaries between ‘disciplines’ in terms of student choice, as paraphrased in the bullets below:

- Interdisciplinary curriculum – teacher-derived subject-centered instruction emphasizing connections between disciplines while striving to maintain each discipline's integrity. Units often taught by a team of different subject-matter teachers.
- Curriculum Integration – student-centered learning whereby themes are decided collaboratively by students and teachers.
- Service-learning – student-directed, project oriented around a “need to know”, centers on tasks meant to improve the community while providing life experiences and interdisciplinary content learning for the students.

The four major national art education organizations have also developed a set of standards, as well as levels that define interdisciplinary instruction (The National Visual Arts Standards K-12, 1994). Throughout these documents, artistic integrity is emphasized. The Association for Supervision and Curriculum Development (ASCD, 1989) also defines different

models that use the root word ‘-disciplinary’ – from *inter-*, and *cross-* to *multi-*, *pluri-* and *trans-* disciplinary (ASCD, 1989).

Other publications use the term *integrated* interchangeably with *interdisciplinary*. In a special issue entitled “What is integrated mathematics and science?” featured in the journal, *School Science and Mathematics*, Underhill (1994) claimed “integrated science and math will never *replace* math *or* science. We can argue about the amount of *intersection...*” (p. 1, italics used by author). Underhill calls for “new experiences” at those intersections, not a focus on what he calls “traditional views of...mathematics-as-procedures and science-as-information” (p. 1). Many articles in the issue share commitment to integrating the processes and content with interdisciplinary curricula (e.g. Berlin & White, 1994; Davideson, Miller, & Metheny, 1994). In a later issue, Davidson, Miller, & Metheny (1995), categorize math and science integration into process/methodological, content/discipline-specific, and thematic categories. A common theme among these authors is an emphasis on authentic integration over trivial or surface connections.

Under the umbrella of teaching models more common to elementary education, *approaches* begin with a method that implicitly crosses disciplinary boundaries. The workshop approach (Saul, et al., 1993; Ernst, 1994; 1997) and the project approach (Katz & Chard, 1989) derive from “a way of teaching and learning, as well as from the content of what is taught and learned” (Katz & Chard, 1989; p. 3). In addition, *inquiry* can designate a way of teaching and learning that cuts across disciplinary boundaries, such as described in the text, *Inquiry at the Window* (Whitin & Whitin, 1997). Inquiry in this case (like the project or workshop approach), is not specifically predicated upon disciplines like science or math. Instead, authentic activities like bird watching form the basis of what then becomes interdisciplinary or integrated teaching and learning.

The National Science Education Standards and science integration

Within the past decade, any research or study in the United States in the field of science education needs to take into account the National Science Education Standards (NRC, 1996). Unfortunately the *Standards*, or NSES, have little to say about using visual arts to teach science. Any references to integration or interdisciplinary issues are limited to math and science, history of science, and technology in science. However, some wisdom can be gleaned from how the NSES is applied to discussions of interdisciplinary teaching in recent science education literature.

A recent issue of *The Science Teacher*, a practitioner's journal for secondary science teachers, is dedicated to art and science. Up until the last few years, authors in this journal were required to cite the NSES; currently, *The Science Teacher* requires that articles "include how the activities addresses current science standards" (p. 21). While half the articles did not cite the NSES in the special issue, and the terms integrated and interdisciplinary were used throughout the special edition (NSTA, 2005), there were no direct references to the NSES in their use. Those that did cite the NSES note that drawing or painting (visual arts) are consistent with science as inquiry (Hobart, 2005; Dambekalns, 2005; Weeks, 2005) and teaching to "individual interests, strengths, experiences and needs" (Hobart, 2005, p. 30).

In a contrasting view, Ault (1998) refers to similar issues of unity in the *Standards*. However, Ault sets a very different tone as he outlines the uniqueness and 'criteria for excellence' within one scientific discipline, geology. While not making any references to age or developmental level, Ault warns against overemphasizing the similarities between the disciplines (within the subject of science) without teaching what he refers to as each discipline's distinct 'criteria for excellence.' He concludes his article with a vague (yet stern) warning:

Good science teaching depends upon resources that represent the demands characteristic of solving problems in distinctive fields of inquiry. Very suspect from this perspective are extreme examples of curriculum reform that treat science not only as a methodology undifferentiated by discipline, but as simply one of many perspectives subsumed by a seamless interdisciplinary curriculum (p. 210-211).

It is unclear whether Ault is referring to places like college science classes exclusively, or if he includes K-12 science teaching as possibly suffering from 'extreme examples of curriculum reform.' Regardless, I now turn to a review of literature on models where science and art are taught together in elementary schools.

Models of using the visual arts to teach science

Numerous examples in the literature espouse the integration of science with other disciplines such as the visual arts. I discuss specific examples most relevant to my study: 1) the workshop and project approaches, 2) language-based approaches to teaching science, and 3) examples in which art is the main avenue for teaching science.

The workshop and project approaches

As noted above, the workshop and project approaches to teaching are common in the elementary school literature. The workshop approach to teaching elementary school was espoused by numerous teacher-researchers in the 1990's (Saul, et al., 1993; Hubbard & Ernst, 1996; Ernst, 1994, 1997). These authors place the emphasis on authentic learning that is student driven. Didactic, teacher-centered lessons are kept to a minimum. From the perspective of these authors, interdisciplinary connections naturally occur and are encouraged.

Artists workshop – Karen Ernst

In an approach she terms “artists workshop,” Ernst (1994; 1997; Hubbard & Ernst, 1996) teaches explicitly for connections and breaking down boundaries in her elementary art room, especially between visual arts and language arts (writing). Her books tell the story of her artist workshops, modeled after writers workshops. She describes, besides the things listed above, great commitment to building community. In the following quote, she combines her focus on community with the need for interdisciplinary work:

We need to work toward making our classrooms workshops of learning—a literate community filled with opportunities for many ways of making meaning, surrounding with works of artists, scientists, writers, and mathematicians, so that students can participate in apprenticeships of learning (p. 166).

Her phrase ‘apprenticeship’ points to Ernst’s belief that teachers model self-learning (and drawing) for the students. In addition Ernst points to the goal of modeling scholarship, not just for her students, but for other teachers. Intertwined throughout her work, Ernst’s (1994) pursuit of *connections* plays a key role in teaching and learning:

I hope to inspire others to reenvision their own classrooms with new eyes, through reading about the parallels and connections between writing and picturing what I saw, and to begin to make their own connections between movement and science, music, and math, and more (p. 167).

Ernst’s (1997) second text on artist’s workshops is more oriented towards teacher learning. In it, she shares many stories of doing art work with her colleagues, usually subscribing to the same rationale of finding connections, when she writes “...we experience real integration

of the curriculum—the overlapping of thought between art, math, science, the multiple lenses necessary to solve problems in learning and life” (p. 4).

Ernst also edited a text with Hubbard (1996) called *New Entries: Learning by Writing and Drawing* (1996). In one of the concluding chapters, she shares her collaborative work with a fourth grade teacher. Through Ernst’s mentorship, this teacher sketched in a journal to model for the students one way to learn science. He and Ernst both encouraged his students to carry “...their journals from artists workshop into their classroom so they could use them to draw, write, and think about their learning in reading, science, social studies, and of course writing” (Ernst, 1996, p. 146). In the same text, an entire chapter is devoted to science, “putting art on the scientist’s palette” (Stein & Power, 1996, p. 59). Many uses of visual arts to learn science are discussed, including: 1) drawing as a tool for observation and part of students’ science toolkits, 2) the notion and rationale that visualization and art need to be encouraged as part of inquiry in science, and 3) the crossing of boundaries in the history of art and science by, among others, Michelangelo. In many ways, Hubbard’s text tells important stories that point to the value of using art to learn science in elementary schools.

Science workshop – Wendy Saul

Like artist workshops, Saul, et al. (1993) offer Science Workshops as an approach to teaching for authentic learning in elementary schools. Also like Ernst’s work, the emphasis is mostly on connections with ‘whole language,’ but in this case, it is science, not visual art. However, throughout the text, drawing and art are implicitly part of the science workshop. The students used art to communicate their science learning, and the authors used their students artwork to support their claim that the students had participated in authentic learning.

However, unlike Ernst's artist's workshop, the value of integration of visual arts and the blurring of boundaries between science and art were not explicitly argued in the text (Saul, et al., 1993). In an interesting connection made in the introductory chapter however, Saul cites James Rutherford, chief educational officer of the American Association for the Advancement of Science. In distinguishing science from other pursuits, Rutherford uses an example commonly known to almost all teachers and children, seashells:

Seashells, for example, are not science; they are just things. Admiring their beauty is not science. Drawing them carefully may or may not be science depending on its purpose. Capturing their beauty is a wonderful thing to do, but it is not science. Trying to figure out things about seashells: that is science... (Saul, et al., 1993, p. 12-13).

Still, Saul uses Rutherford's quote to justify teaching writing and reading to learn science and encourages teachers to "capitalize on intellectual 'crossovers,' not fight them" (p. 15). The emphasis on connections and authentic learning are among the many ways Science and Artist Workshops share features with another approach which naturally fits within a discussion of children drawing, painting, and learning science...the project approach.

Katz and Chard (1989) lay out a persuasive argument for *Engaging Children's Minds: The Project Approach*. As their title implies, they define and describe a way of teaching students that centers on student interests pursued through projects, defined as "an in-depth study of a particular topic that one or more children undertake. It consists of exploring a topic or theme such as 'going to the hospital,' or 'building a house'..." (p. 2). Among the many parts of their rationale is that students' interactions with the content learned is more active, motivating, and long-lasting. Katz and Chard (1989) are critical about what they consider is most schools' over

emphasis on formal academic instruction, in which teachers spend “too much time and energy on directions and instructions” (p. 43).

Emphasizing the important role that drawing, painting and writing can play in the curriculum, Katz and Chard (1989) explain, “because various kinds of art work and writing are important ways of communicating understandings, teachers can encourage children to apply these skills in project work” (p. 105). The authors describe how students’ drawings and paintings are displayed on bulletin boards and used to solve problems during projects and are used as a form of assessment.

Science and language integration through Science Talks – Karen Gallas

Karen Gallas (1991, 1994, 1995) is known for her innovative work as a teacher-researcher. In her first grade classroom, she spends considerable time and energy using drawing and painting to teach language arts and science. Indeed, Gallas (1994) claims that children’s art-making skills are an essential part of their language repertoire, just as other forms of expression, like talking and writing, help them to communicate and learn. She stresses “...that language was not confined to ‘scientific’ talk; it was poetic, visual, analogical, kinetic” (p. 72).

In both her texts, *The Languages of Learning* (1994) and an entire text on what she terms ‘*Science Talk*’ (1995), she makes numerous references to the natural connections in learning art and science. For example, she espouses the value of, as she puts it, a “multi-arts curriculum that places the arts as central to the completion of the curricular process” (p. 132). In her classroom, students kept science journals that included sketches and examples of illustrated poetry on science ideas. While discussing a specific series of Science Talks on the circulatory and nervous systems, Gallas (1995) wrote:

As always, right after the talk I asked the children to draw an idea or ideas, that they felt answered the (science) question best. Their drawings summarized the main points of the Science Talk and included the original theory that the blood told the brain what to do.

Gallas (1994) notes the power of using “the arts to respond to the developmental needs of my students within the context of a required science curriculum” (p. 75-76). In a particularly powerful story, she told of her work with Juan, a second language learner who always chose to draw or paint over write or talk. She wrote of his drawings:

...visual representations became a catalogue of science information and science questions, and that information began to provide material for his involvement in reading and writing and learning a new language. As Juan drew, we built a reading and speaking vocabulary from his pictures, and that vocabulary, together with his interest in representing science, also became the subject matter of his writing (p. 132).

Inquiry at the window

In *Inquiry in the Window*, Whitin and Whitin (1997) tell their story of a yearlong interdisciplinary inquiry of birds in a fourth grade classroom. Science was most often mentioned as a focal point, along with math, language arts, and history. Drawing and models (student-created drawings) were created as tools for understanding and communicating. Stories of how scientific understandings were generated, how drawings helped the creators, and how students studied their peers’ drawings, are included in their ethnography. They express what they thought about drawing but did not investigate in their study>

We did not pursue the potential of drawing for expressing understandings about birds.

Even though we certainly encouraged the children to draw throughout the study, we did not keep systematic records of these drawings or invite the children to describe the

process they used to create them. Although we realized more and more that drawings were a powerful avenue for conveying observations and theories, we found that we had usually confined these drawings to the private learning experiences. We did not capitalize on the drawings as a vehicle for generating group knowledge (p. 122).

Art to teach science in elementary teacher education

While not in elementary schools, Osborne and Brady (2000, 2001) use narrative research to tell stories of three different graduate classes for elementary teachers, all with the explicit goal of blurring boundaries between art and science. Inspired by their readings of Dewey (among others), they believed that “by merging science and art in classrooms students develop a sense of the dialectic between rationality and the aesthetic, between emotional responses and intellect” (p. 31). Many important questions and experiences are shared and explored with the students (who consist of equal numbers of elementary teachers and full-time graduate students) on issues of teaching art, science, and other traditional separate disciplines.

In the following quote, Osborne and Brady (2000) summarize their goals of using art to teach science, as well as the resulting questions and dialogue:

In our classes we use art (images) – doing/making art, looking at/critiquing art – as a vehicle to see new things, enlarge the creative possibilities of doing basic science, and redefine science in our students’ minds. We use the making of art around scientific topics to enlarge observation of all domains – content, process and subject matter – and to enable conversations about the nature of “seeing;” what things are “seen by science?

What are “seen” by art? (p. 27)

Osborne and Brady’s (2000 & 2001) use of visual arts centered on Gyotaku, a traditional Japanese print-making technique (or ‘Fish prints’), field trips to Brady’s applied science center,

and explorations into ‘magical-realist texts’ (literary genre). While the results are tentative from their exploratory study, Osborne and Brady point with enthusiasm to the possibilities of teaching science using art.

Practitioner articles and curricular materials related to using art to teach science

The combination of visual arts and science is a subject ripe with fruit for the picking in practitioner-oriented journals (e.g. entire issue of *The Science Teacher* whose focus was ‘Art and Science,’ NSTA, 2005). While declaring they are “peer-reviewed scholarly journals” (e.g. *The Science Teacher*, NSTA, 2005), these monthly publications, when compared with research journals oriented towards educational researchers (e.g. *Science Education*), are brief and lack detail on theory, supporting studies, methods, and empirical evidence. Even less oriented towards educational researchers are the many curricular materials and texts that combine science and art, such as *Science Art* (Schechter, 1997) and *The Art and Science Connection* (Tolley, 1994). Even so, articles specific to this study provide important direction with which to analyze data (among other things).

Gainer and Child (1986), in an article in *Art Education*, briefly tell the story of a summer program at Woods Hole Marine Station that was adapted and implemented in an elementary school. In particular, Gainer and Child denote this unique combination of science and art as available to elementary teachers:

Scientific illustration provides a method for students to develop visual acuity and drawing proficiency as they participate in artistic and scientific traditions and glean a most gratifying association with the natural world (p. 22).

In addition, Gainer and Child (1986) emphasize the importance of student exhibits as culminating events in these art and science units, as well as the particular values they view

inherent in scientific illustration compared with more commonly used art-making activities in elementary classrooms that emphasize “the spontaneous, unique and often, haphazard” (p. 19).

In the next section, I turn to the educational literature used to construct my theoretical framework.

Theoretical Framework

This section provides an overview and discussion of the theoretical framework. I begin with a brief description of its purpose using a figure. Turning to the substance of the framework, I discuss the epistemological differences between two major educational theorists, Dewey and Vygotsky and two approaches to teaching science, each largely derived from their respective theories.

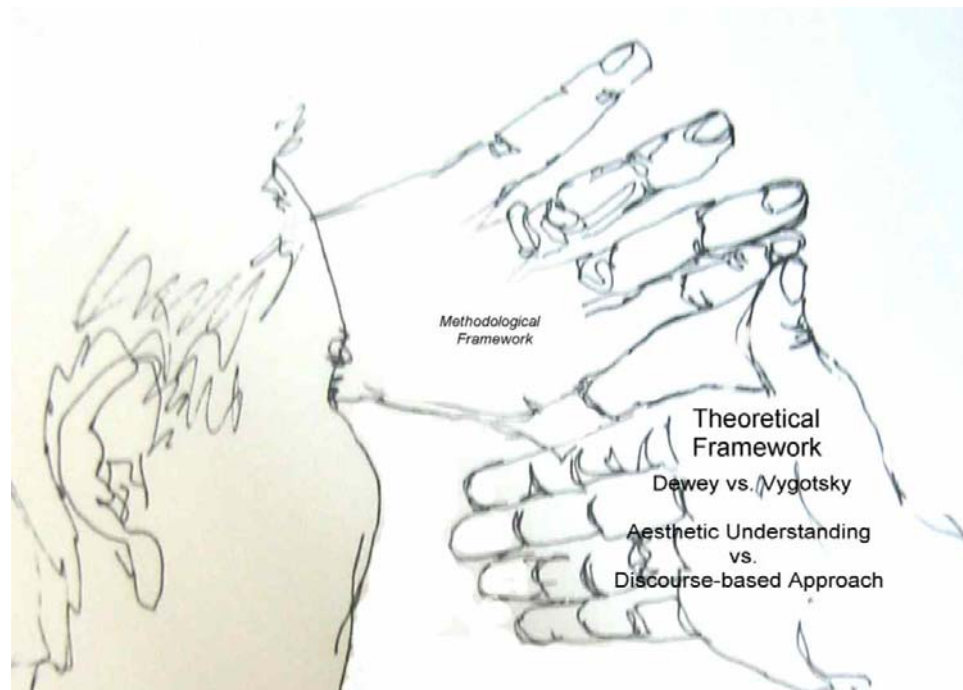


Figure 2.1. I sketched the framing of an artist’s hands to represent the interaction of the theoretical and methodological frameworks to view the research experience (11/2004).

In Figure 2.1 I use text and a self-portrait to illustrate what I believe to be the purpose of the theoretical framework. Used in conjunction with the methodological framework, the major

theories act to focus the artist-researcher's attention while screening out things not pertinent to the study. The 'window' formed by the two hands forces the researcher to focus on a 'scene' while removing the peripheral forms from the artist-researcher's gaze. The 'window frame' (the surface of the hands) if defined explicitly and labeled like the ones in Figure 2.1, remind the artist-researcher what to look for in the scene. The theoretical framework (my right hand in Figure 2.1) is labeled with a pair of contrasting phrases: Dewey versus Vygotsky and aesthetic understanding versus discourse-based approach. I discuss the relevance of each of those phrases in the subsections below.

Two articles contrasting the approaches to teaching and learning of John Dewey and L.S. Vygotsky

Many theories resonated with me through the course of this study. In this section, I describe two key articles that, when combined, explicate the theories that make up my framework. They also provide the key foundation for enabling me to formalize the way I look across my data, stories, and experiences to define overarching tensions of the study. Both articles explain so much of what I had intuitively viewed as the value of using drawing and painting to teach science.

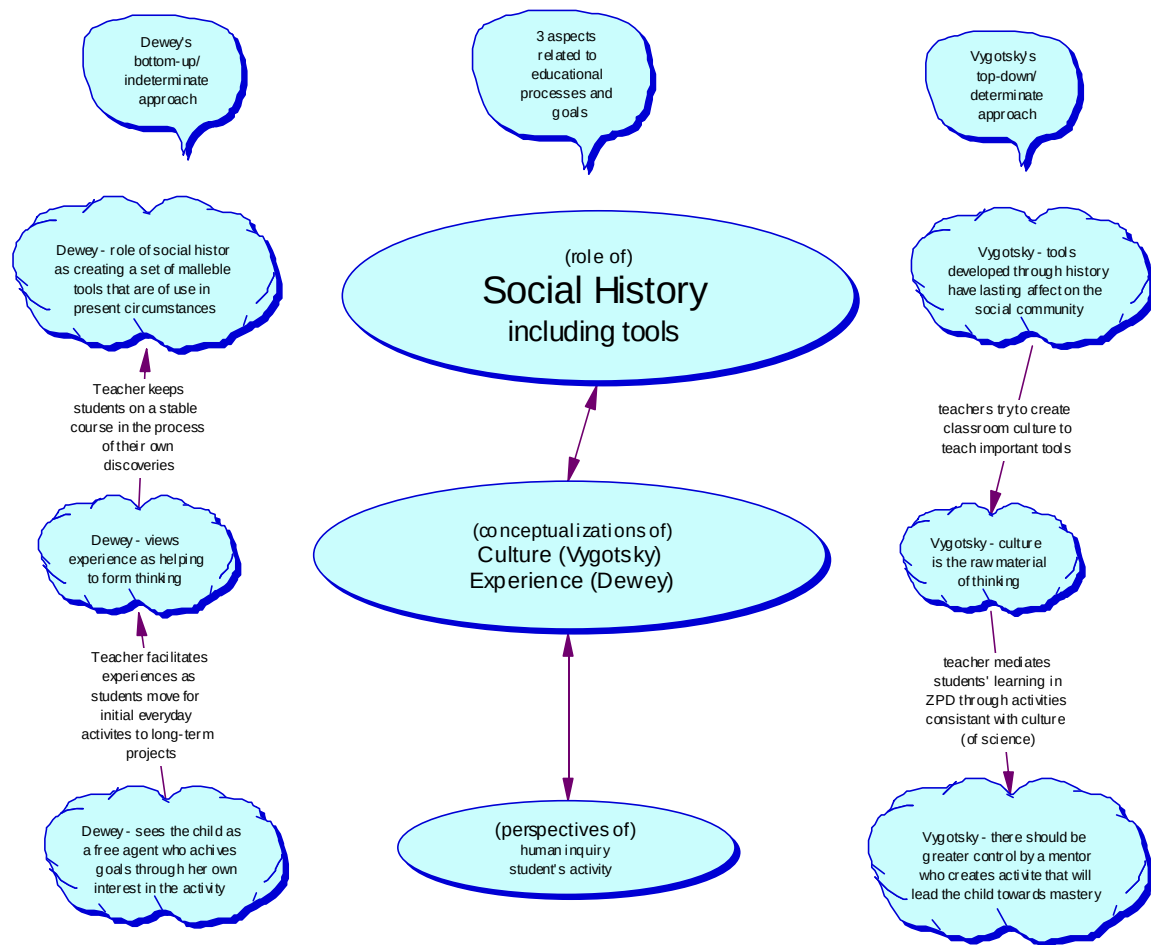
Glassman's analysis of Dewey vs. Vygotsky

Michael Glassman (2001) wrote an article in *Educational Researcher* called, "Dewey and Vygotsky: Society, experience, and inquiry in educational practice." After struggling to apply Dewey to fit my specific needs in writing my prospectus and after the long and rich experience in trying out what I had not understood theoretically, reading Glassman's article was extremely exciting for me. I frantically circled and underlined words and wrote notes in the margins of my copy. I scribbled into my field notebook and chopped away at my laptop. Perhaps the most

exciting part of reading that article was not that I was finding a way to make sense of the experience. Rather, it was that I found in Glassman's words affirmation that I always regarded teaching and learning in very similar ways to Dewey's later beliefs. And it was also so clear that when viewing teaching and learning through that lens, it was no wonder why I had beat my head against the institutional walls of the classroom as a teacher and an educational researcher. To make matters even better, my perceptions of Annette's dispositions on teaching and learning echoed those of Vygotsky, at least in the ways Glassman described his theories.

Glassman (2001) uses three categories to contrast the differences between Dewey and Vygotsky in terms of their theories on learning, teaching, and schooling: 1) the role of social history in relation to tools, 2) the ways experience and culture were conceptualized, and 3) the place of human inquiry in student learning and schools. Below I have organized Glassman's words into a figure to contrast how Dewey and Vygotsky theorize learning as related to three categories

According to Glassman (2001), Dewey believed that the consequences of activity were far less important than the processes of activity when compared with Vygotsky. Their difference in views on the relative value of the outcomes of activities was based, at least in part, on the contexts of their educational systems. Vygotsky was part of an educational system in Soviet Russia that sought to instill Marxist values to all its citizens. On the other hand, Dewey found himself critiquing a U. S. education that was becoming increasingly mechanized even though the nation claimed democratic beliefs (Glassman, 2001)..



last revised 11/9/04

Figure 2.2 A graphic organizer of Glassman's (2001) comparison of Vygotsky and Dewey based on their theoretical differences in terms of three key aspects of education.

The value of the consequences of activities is reflected directly in the two ways the role of the teacher was viewed by Dewey and Vygotsky. According to Dewey, the role of the teacher was to engage students in authentic activities and learning in a way that would allow students to follow their interests and engage in new and authentic activities. The teacher therefore starts the planning process finding activities that will engage students' curiosity. Teachers should facilitate the students' activities only in ways that help the students to develop their own long-term projects. According to Glassman, Dewey believed that any real engagement in authentic

activities or “progressive problem solving” (p. 10) would inevitably result in valuable, though unpredictable learning outcomes. While Vygotsky also considered progressive problem solving through an activity to be central to good teaching, he thought educators should begin planning instruction with a firm understanding and clear set of goals on the subject to be taught. For example, science is a discipline within humanity’s social history and its resulting tools and fundamental concepts form the starting point for the educational process. That is, according to Vygotsky, teachers should begin planning instruction by outlining the goals, then deciding how to establish a classroom culture whereby students can use scientific tools. Finally, Vygotsky believed teachers should design specific activities whereby students work with more capable peers, including the teacher, to learn scientific concepts using scientific tools in scientifically appropriate ways.

Glassman (2001) clarifies the difference between Dewey and Vygotsky by contrasting two educational models: 1) long-term projects, Katz and Chard’s (1989) model within their project approach to teaching, and 2) the zone of proximal development or ZPD. Vygotsky’s notion of ZPD is that learning occurs in that ‘place’ (or zone) where a child interacts with concepts and processes at a level just higher than his/her own. The learning situations require a teacher or more capable peer. Teachers are expected to plan instruction carefully to increase the probability that students work on problems within their ZPD. The planning starts with the subject to be taught, which should be a valid part of the larger social history within which the student and teacher find themselves.

Using long term projects, according to Glassman (2002,) calls for teachers to take on a very different role. In the following quote, he describes how topics are chosen and a teacher’s role:

The topic need not be of any relevance to the demands of the larger social community, or even have meaning or interest for the teacher. As a matter a fact, the teacher should step back from the process once children display a relevant interest and act a facilitator rather than mentor (p. 4).

It is no wonder that the theories and resulting models of both Vygotsky and Dewey tend to resonate with teacher-researchers who espouse activity-centered instruction in their classrooms. However, Glassman's analysis of the similarities and differences between their theories provides a starting point for the development of a workable model to compare and contrast my own views and approaches to teaching and learning with those of the classroom teacher. In the next section, I describe the work of an elementary science teacher-researcher who claims as his theoretical framework Dewey's notion of aesthetic understanding.

Girod's comparison of aesthetic understanding with competing theories of science learning

Like my own study, Mark Girod (2001) also did his dissertation in the field of elementary science education utilizing Dewey's notions of artistic experience. It is titled *Teaching for aesthetic understanding in a fifth grade classroom*. In a resulting publication, Girod and Wong (2002) propose that one could understand competing theories of science learning by answering the following six questions:

- To what epistemological tenets does the theory subscribe?
- What is the role of the learner?
- What motivates learning?
- How is science learned?
- What would be the central curricular organizer in the theory?

- What is the role of the teacher? (p. 200).

Using these questions, Girod and Wong (2002) compare what they term “aesthetic understanding” (p. 200) to two other commonly used learning theories in science education, conceptual change learning and discourses-based understanding. All of the ways aesthetic learning was described using those questions reaffirmed that Dewey’s theories on experience and particularly artistic experience was the best fit for my theoretical framework. It both explained my own intuitive notions of teaching, learning, and research as well as contrasted with my perceptions of the classroom teacher’s views on those topics. To me, her conceptions seemed to be based more on discourse-based understanding than on aesthetic understanding. And reading Glassman’s analysis of Vygotsky’s work, discourse-based understanding, with its emphasis on language as a cultural tool and social mediator fit under the ‘Vygotsky’ umbrella.

So between Girod and Wong’s (2002) six questions on the competing theories of science learning and Glassman’s (2001) analysis of the differences between Vygotsky and Dewey, I had the makings of a theoretical framework for this study. Yet I needed to combine them into a working model so that I could interpret the data in meaningful ways.

A matrix of the theoretical framework

I combined ideas that make up my working theoretical framework into one matrix represented below in Table 2.1. I place questions across the top row based on Glassman’s (2001) “key points” (p. 3). Down the left column, I incorporated versions of Girod and Wong’s (2002) six questions (that they used to explore science learning theories). In each case, I modified the original questions or categories in ways that rendered them useful in making sense of the data from my study. In other words, I used the matrix to ‘ask’ questions of my field/interim texts and answer each question in the appropriate ‘box.’ Each box is an intersection of two questions. For

example, in the uppermost left box, the questions are: In relation to science teaching and art in science, what are the ways we seem to perceive the roles of social history and its tools? *and* What are the ways we seem to define *knowledge*? In this example, I would combine the questions to ask myself: Based on this field (or interim) text, what are the ways that the classroom teacher and the university researcher seem to be viewing the nature of learning that relate to the big pictures of social history and tools like language. Are there differences in our answers to this question? Are there similarities?

To use the bottom-most, far-right box in the table above, the questions are: What seems to be our viewpoints on human inquiry and student's activity? Specifically in the roles we seem to perceive they play in teaching science? *and* What do we seem to believe our roles as teachers should be? In other words, how do I perceive the ways the classroom teacher and university researcher define our roles (as teachers) in the students' activities as human inquiry? Using the answers I attribute to Girod and Wong (2002) and Glassman (2001), I could specify the question, Do we seem to view ourselves as guiding/mentoring students to correct their misconceptions through science talk during those activities? Or do we perceive our roles as setting up environments where we facilitate student inquiries in which they themselves find truth and beauty in the natural world?

As a further guide to making sense of my data, brief answers to the questions are recorded above or to the left. These 'answers,' also modified from the two Glassman (2001) and Girod and Wong (2002) articles, contrast Dewey and Vygotsky's theories. During data analysis,

Table 2.1. A matrix used to view data (field and interim texts) through my theoretical lens based on contrasting Dewey and Vygotsky and Aesthetic Understanding/Discourse-based Approach

Tensions		Memos, questions and things that don't fit in matrix	My questions of my field and interim texts; modified from Glassman's (2001) key points related to educational processes and goals		
• • • • • •		• • • • • •	Dewey - As creating a set of malleable tools that are of use in present circumstances	Views experience as helping to form thinking	Sees the child as a free agent who achieves goals through her own interest in the activity
			Vygotsky - Tools developed through history have lasting affect on the social community	Culture is the raw material of thinking	There should be greater control by a mentor who creates activity that leads child towards mastery
			In relation to science teaching and art in science, what are the ways we seem to perceive the roles of social history and its tools?	How do we seem to conceptualize and actualize culture and/or experience? (ex: culture of science and school sci, artistic experiences in science)	What seem to be our viewpoints on human inquiry and student's activity? Specifically in the roles we seem to perceive they play in teaching sci?
Aesthetic understanding (via Dewey) (from Girod & Wong, 2002)	Discourse-based understanding (via Vygotsky) (from Girod & Wong, 2002)	My questions of my field and interim texts (from Girod & Wong, 2002)			
In action and in the world	In the group (language & participation w others)	What are the ways we seem to defining knowledge?			
Active in verifying potential of ideas; process of verification is both individual as well as socially and culturally situated.	Being active in constructing and co-constructing knowledge with others	What seems to be the role of the learner? What do we seem to believe the role of the learner should be?			
Anticipation of possibilities; desire to try out ideas	The desire to do that through participation in a group	What seems to motivate learning? What do we seem to believe about what motivates learning?			
Having aesthetic experiences with subject-matter ideas.	Appropriating language; participation in a group	How does learning seem to occur? How do we seem to believe learning occurs?			
Ideas; experiences	Language, participation	What seems to be our central curricular organizer (in our theories)?			
Help students see possibilities for sci ideas to reshape the world; truth/beauty	Help students adopt ways of talking science; scaffold science identities	What do we seem to believe our roles as teachers should be?			

these brief comparative answers to each question offered me a quick reference as I looked for the ways the classroom teacher and I viewed teaching and learning.

Conclusions

In this chapter I sought to do: 1) represent the literature base that informs and contextualizes my study, and 2) describe the theoretical framework that would help define the ways I analyze my data and make sense of my research experiences. I return to the image of the researcher-artist using his hands to both frame his intended composition and screen out the forms not essential to his work but still part of the overall environment. I view this overall environment (outside the hands) as the literature base, and the framing hands as my theoretical framework (and methodological framework that will be described in the next chapter. I draw on another metaphor, one more commonly used in human inquiry. I believe I must both see the forest for the trees *and* the trees in the forest. To help *see* the forest, I engaged in the literature review. To help focus in to *see* the trees, I constructed a theoretical framework that meshed with my methodological framework. In the next chapter, I describe the latter as well as laying out the method I used to collect, analyze, and represent the data.

CHAPTER 3

METHODOLOGY



Figure 3.1. My 'study-scape': A line drawing representing the entire study with a focus on the methodology (March, 2003).

A picture is worth a thousand words. I think Figure 3.1 is worth many more. Even so, I must use words to explain how I conducted my study. Since I claim my study to be an arts-based narrative inquiry, I feel comfortable using not just words, but also images, including my own drawings and paintings, to explain how I carried out the study. Therefore, let's get to it. I tried to draw the whole study encompassed in one scene, one picture. I call the image 'my study-scape'.

It includes many parts, just like most landscapes. And each part of *my study-scape* will be explained below and used to explain the different aspects of my methodology. I begin with my research questions, followed by methodological perspective, context of the study, participants, timeline, data sources and procedures, and conclude with data analysis/representation and trustworthiness.

The purpose of this study was to explore how the visual arts could be used to teach elementary science through a collaboration between a university science educator (myself) and a fifth grade classroom teacher (Annette Santana). Originally, the purpose was solely to investigate how I learned to plan and teach science through the visual arts. The purpose became twofold when the inquiry veered from a self-study to a co-research study with the classroom teacher, thus bringing the nature of collaboration into the scope of the study.

The following research question guided the study: *What happens when teachers collaborate to plan and implement arts-based science units?* This question is, by design, a very open-ended question. I worded this question as such so that my study could take a naturalistic path similar to teacher action research (this will be addressed further below). Therefore, as the research process unfolded, more specific guiding questions and subquestions were developed to focus the study. Under each of the guiding questions, I have listed the subquestions as well.

- 1) What facilitates and constrains the development and implementation of units centered on the visual arts to teach and learn science?
 - a) How do I conceptualize the relationship between curriculum and teaching?
 - b) How does this change throughout the course of the study (if any)?
- 2) How do teachers collaborate to plan and implement arts-based science units?

- a) How do my perceptions and experiences of the planning and teaching of science units compare with those of the classroom teacher and students?
- b) What facilitates and constrains the collaboration to plan and implement arts-based science units?

I now provide a rationale for my choice of methodology. Answering the questions above required many things; to name a few: trying to teach a unit, a lot of self-reflection and co-reflection with Annette, teaching another unit, starting the cycle over again, all the while documenting the interrelated processes as best as I could. I claim arts-based narrative inquiry or ABNI (Diamond & Mullen, 1999) as my methodology because this approach focuses on teachers examining their own practice in ways that open the door to using artistic and other qualitative means to collect, analyze and represent the data and findings. I documented the collaboration through visual data like digital photos and my own drawings and paintings as well as audiotapes and journaling. These data were analyzed in a dialectic manner, which involved typical inductive qualitative data analysis (analysis of narratives), and the generation and revision of stories that included text and illustrations (narrative analysis). Based on the results of those processes, I then engaged in cross-case analysis to find overarching patterns and tensions across the findings. In keeping with the artistic nature of the methodology, I represented my findings in ways that emphasized the aesthetic – that is, I worked to allow readers to vicariously experience that which I experienced through the use of textual and visual narratives embodying the use of senses and perceptions (Barone & Eisner, 1997).

Arts-based narrative inquiry is a very open-ended and liberating approach to educational research. ABNI revolves around teachers learning how to be better teachers by looking at their

own work through a variety of means, including artistic ways of knowing. Diamond and Mullen (1999) state this central tenet of ABNI in the following quote:

The developmental version of teacher education emphasizes the centrality of teachers as makers of an epistemology of their practice that is actively researched and reflected upon. As artists, teacher researchers engage in re/vision, novelty, and reflexivity (p. 20).

In arts-based narrative inquiries, complexity and multiple truths are sought and valued as teacher-researchers seek to make sense of their experiences (Diamond & Mullen, 1999). Self-exploration and expression are also valued. The resulting products are not so much distillations of research experiences into propositional statements supported by text-based evidence; rather, the researcher uses arts-based narratives in an attempt to relay the intricacies and complexities of the teaching and learning experiences (Bruner, 1986; Eisner, 1993).

The media I used (methods) as well as how I used those media (data collection and representation) were unique to me and reflect my own strengths and weaknesses. Diamond and Mullen (1999) claim that teachers need to make use of all the skills and strengths they have available to reflect on and grow in their practice. In this study I used the many tools available to me to mediate meaning (Wertsch, 1991), from artistic processes and products to stories, metaphors and analogies.

We are the research tools, Annette (the classroom teacher) and I – our perceptions and the resulting experiences (Eisner, 1991) some shared, some unique. While it was a collaborative study, that is, a study with multiple faces, my voice still dominates over that of Annette or the students. The focus is more on me and how I work with Annette; but secondary foci include how she works with me, her perceptions and experiences, and to a lesser degree, the students' experiences and perceptions. The data collected for our work together is filtered through *my* lens

of course; even so, arts-based narrative inquiry allows room for Annette to be a co-researcher as well as co-participant. That is, although we co-planned and co-taught in a process that comprises my dissertation project; I still tried very hard to also include Annette in that research process as well being an instructional partner.

For the reasons described above, I claim arts-based narrative inquiry as my methodology. Within the framework of this methodology, I next go into detail about the specifics that shape how I answered my research and guiding questions. Starting with my methodological perspective, I use a line drawing to visualize and introduce all the major components of how I sought to answer the research questions, including research contexts and participants; as well as data collection, analysis, and representation.

Methodological Perspective

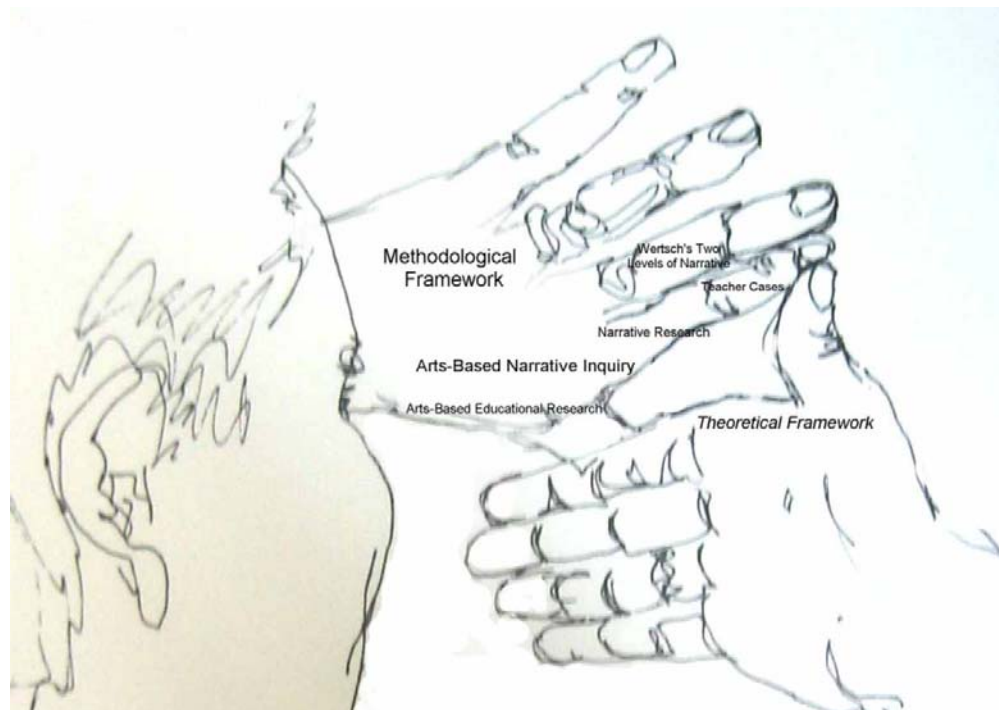


Figure 3.2. My left hand frames my field of vision and represents my methodological framework.

Together with my theoretical framework, my methodological framework completes the molding that defines this study, just as artists use their hands to explore and limit the possibilities of their field of vision. The main influence on my perspective (used interchangeably with framework) is described by Diamond and Mullen (1999) as Arts-Based Narrative Inquiry.

Specifically, my own arts-based narrative inquiry draws on two major strands of educational research (see the fingers on Figure 3.2 above): 1) arts-based educational research or ABER (Barone & Eisner, 1997), and 2) narrative research (Clandinin & Connelly, 2000). Within the field of narrative research, I find specific influences that frame my study. Those spheres of influence include Wertsch's (2002) notions of narratives as specific narratives and schematic narrative templates, and teacher cases (Tippins, Koballa, and Payne, 2002; Koballa and Tippins, 2004) and the inclusion of images as narratives, including photos (Banks, 2001) and drawings/paintings (Gallas, 1994). Also helping to frame the study (see Figure 3.2 above) is participatory action research (Eldon & Levin, 1991). While my study is not framed solely as such, aspects of this participatory action research are consistent within my framework of arts-based narrative inquiry. That is, the collaborative (i.e. participatory) study of teaching (the action) through trial and error and reflection. What follows next is a description of each of the major strands of educational research that comprise my methodological framework.

Arts-based Educational Research

Eisner is often credited, along with Barone, with pioneering the field of arts-based educational research. He alludes to his motives and difficulties in the following quote from his methodological text, *The Enlightened Eye* (1997):

The arts and humanities have provided a long tradition of ways of describing, interpreting, and appraising the world: history, art, literature, dance, drama, poetry, and

music are among the most important forms through which humans have represented and shaped their experience. These forms have not been significant in educational inquiry for reasons that have to do with a limited and limiting conception of knowledge (p. 2).

Thankfully, what counts for knowledge in educational research has expanded to include the arts (as illustrated by the theme of the 2005 Conference on Interdisciplinary Qualitative Research (QUIG): Art as research, Research as art).

This methodology has an emphasis on experience and aesthetics, especially in data representation. In other words, audience responses to the ‘research texts’ (Clandinin and Connelly, 2000) are paramount to the arts-based narratives according to Conle (2003). In an article that categorizes the many different types of narrative research, Conle notes there is an explicit emphasis within arts-based research to help readers (or viewers) *experience* their work in meaningful ways. Indeed, Barone and Eisner (1997) refer to affective arts-based texts as affording readers powerful vicarious experience.

Barone and Eisner (1997) describe seven attributes that can help to demarcate arts-based educational inquiry:

1. The creation of a virtual reality,
2. The presence of ambiguity,
3. The use of expressive language,
4. The use of contextualized and vernacular language,
5. The promotion of empathy,
6. Personal signature of the research/writer,
7. The presence of aesthetic form (p. 73-78).

These qualities helped to form my methodological perspective, as well as inform the ways I sought to represent my data and findings. The text includes a story in which Barone includes the seven attributes above and hints at how research experiences can be transformed into research reports. Indeed, a powerful way to understand experience and represent it to readers is through story. In the next section, I discuss how narrative research and specific types within that field help to frame my study.

Narrative Research

Clandinin and Connelly (1994, 2000) are often cited and looked to as leaders in the field of narrative research in education; of special significance to them are the ways teachers use narrative means to make sense of and represent their own experiences. Teachers' personal stories as curriculum have much to add to educational research but are often ignored (Connelly & Clandinin, 1988). A central component of my study is how I develop and grow as a teacher through meaning-making in arts-based narrative ways. My experience as a science teacher and teacher-researcher is a central focus of this study. In referring to Dewey's conception of experience, Clandinin and Connelly (1994) echo my goal in their research in writing: "our primary interest in experience is the growth and transformation in the life stories we, our students, and research participants author" (p. 418).

In earlier work, Connelly and Clandinin (1988) support the idea that teachers and students can use their personal experiences as starting points for designing learning opportunities. From their perspective, autobiographical reflection is the way of finding these starting points and opportunities (Connelly & Clandinin, 1988).

In a similar way to Eisner's call for what counts as knowledge, I claim that what is typically considered as narrative needs to be expanded to more than just a story told in words.

Specifically, I claim that visuals can be a form of narrative. For example, in his text on image-based qualitative research, Banks (2001) describes photos as narratives. Gallas (1994) includes children's drawings and paintings within the realm of narratives, citing Bakhtin's notion of narrative as any complex set of symbols. I use these works to justify my use of combining 'image-based' and 'text-based' narratives in striving for the most powerful stories reflective of my research experience, a goal consistent with Barone and Eisner's (1997) attributes of arts-based educational research.

Wertsch's notions of specific narratives and schematic narrative templates

According to James Wertsch (2002) a prominent educational psychologist, narratives fall within two realms, specific narratives and schematic narrative templates. Specific narratives are defined "in the Western tradition that have specific settings, characters, and events" (p. 60). Another way to describe these is in terms of the traditional sense of stories that have a beginning, middle, and end.

Wertsch contrasts specific narratives in larger forms when looking at "the role of narrative as a cultural tool...to contrast this sort of specific narrative with more generalized, abstract forms, the latter being schematic narrative templates" (p. 60). Additional details on these specific and schematic narratives will be provided subsequently in the data analysis section.

Teacher cases

Not to be confused with 'case study,' teacher cases are a type of narrative most often used in teacher education (Shulman, 1992) including science teacher education (Tippins, Koballa, & Payne, 2002; Koballa & Tippins, 2004). As part of case-based pedagogy, these stories often revolve around classroom dilemmas. Cases have no simple solutions; instead, they reflect the complexities and multiple truths of the complex social interactions teachers face.

Viewing my experiences in the study as teacher cases has helped frame those experiences in narrative ways; therefore cases have served as an integral part of my methodological perspective. Having pointed to the major concepts that comprise this study's theoretical and methodological frameworks, I turn to the context of the study, starting with the school.

Context of the Study

I strived to keep the scope of this study restricted to one classroom. Even so, the elementary school of which that classroom is a part of is like any school – an incredibly complex place with invisible but powerful undercurrents flowing from within and outside the. I only touch upon the most salient aspects of it that are specific to this study, acknowledging the limited view I take here.

Nelson Elementary School (pseudonym) was chosen to be one of the two schools partnered with a nearby university and other community organizations to create a 'community learning center.' As such, the stated goal of the five year project was to transform it from a 'traditional' school "that basically provides for students' academic needs in teacher-centered classrooms into community learning centers where the student needs are at the forefront and community social services agencies are involved with educators to provide for the whole child" (Partnership document, 2/2002). In addition to shifting to a 'year-round' school calendar, Nelson Elementary School became the site of many new collaborations between teachers, students, and 'outsiders' like university researchers and educators. I can only say that, given my limited understanding and involvement in the larger picture, any further claims about Nelson Elementary School would be at the risk of misusing my privileged voice as a university researcher (Hayes & Kelley, 2001).

Annette's Classroom

Annette Santana's classroom seemed to me like a wonderfully busy place. In her room, students seemed to always know what the expectations were and held each other accountable for them. It was not always quiet, but it was safe. It seemed to me like everyone knew what was expected and found those expectations appropriate. It was also the most democratic classroom I had ever experienced; all the fifth graders held classroom positions of responsibility and were held accountable by their classmates; everyone seemed to have a say in what was expected of them, and learning was often collaborative. Students sat in 'clusters' of desks like islands within islands. But often, they sat on the carpet looking up at Annette, the flipchart, or the chalkboard.



Figure 3.3. This panoramic photo shows Annette, the fifth graders, and many of the physical aspects of the classroom.

Upon entering Annette's classroom, I was amazed at her ability to make classroom management decisions quickly, fairly, and decisively. This was important to the democratic nature of her classroom.

In saying she had a comparatively democratic classroom, I am not claiming that Annette was always nurturing or especially sympathetic to her students' particular situations. Indeed, she constantly reminded them when they were not meeting expectations and only commended behaviors and student effort when it was clear they had worked hard. Therefore, when she complimented students, it almost always showed in their faces immediately. And often when a

few got out of line, Annette lectured to the entire class; but there were also structures in place so the students could keep each other in line. For example, students alternated in keeping track of positive and negative points that reflected individual students' behavior.

Participants, peer debriefers, and writing groups

The primary participants in this study were myself and Annette (described below). The label I use for myself (when not using pronouns) is *research-coteacher*. I describe the research-co-teacher using the following labels: White; male; middleclass; highly-educated; a member of the 'culture of power;' a science educator/former high school science teacher; a 34 year-old graduate student; local artist; and most importantly, a married father. Successful completion of this project will result in my third degree in the field of science education. However, from the onside of this study I actively sought to bridge two careers: those of both artist and science educator. Below are selected self-portraits I have done in an effort to represent not only how I believe I look to others but also how I see myself.



Figure 3.4. Two self portraits.

The image on the left (done May 2003) was a Conte crayon drawing representing my reaction to what I would consider an inappropriate use of academic language...what I would term the “fancy words that don’t say anything.” The portrait on the right was done most recently (December 2003) and as realistically as possible. I tried to depict the natural expression my face takes when I am at rest and not showing much emotion.

Annette was the other primary participant and when not addressing her by name, I use the label *classroom-coteacher*. I hesitate to describe Annette in the same way I describe myself above, having found that she resists and resents the labels that are so often applied to our relative differences as people. Throwing aside any illusions of researcher objectivity, I do *not* hesitate to say that Annette is a great person; she is kind, honest, consistent, extremely dependable, wise, very pragmatic, fun and funny, loving, quietly confident, strong and brave, smart and one of the most capable people I have ever worked with. Annette is also very, very different from me. To illustrate that point, I will use one type of ‘people label,’ one Annette and I discussed a lot in good-humored ways throughout our work together. Annette has the Meyers-Briggs personality type of ISTJ or the “field general,” and I have the opposite label of ENFP or “the journalist.”

I include two drawings done early in my time in Annette’s classroom, both reflective of one of her favorite thing to do and to teach – reading. In the image on the left of Figure 3.5 below, Annette reads aloud to the class. She is the one with her legs crossed over each other directly below the word ‘Reading.’ I did that contour drawing while she and the students were reading together.



Figure 3.5 Two of my research drawings of Annette, the gesture drawing on the right is done with pencil (Field Journal, 8/5/2003), the contour drawing on the left, in ink (6/18/2003).

Secondary participants – the students

I worked with Annette over the course of two different school years, and with two very different groups of students. The students in Annette's fifth grade class for the 2002-2003 school year were included in this study; however, no data were collected on these students. Instead, the focus was on my relationship to Annette as we co-planned, co-taught, and co-reflected on our first unit together in June, 2003. The second group of students (2003-2004 school year) entered my study as secondary participants. While the primary focus of the study remained on my collaboration with Annette, I took into account the students' experiences and learning in an effort to further understand our teaching.

The second year's group of students was larger and more diverse than the first group. Of the 23 students, 16 students were African-American, four were White, two were Latino, and one was Asian; 13 students were female, 10 male; four students were labeled gifted and four other students were labeled with learning disabilities. The group was very heterogeneous in terms of

skills, attitudes, and backgrounds. As a group, Annette described them as talkative but pretty good, capable of a lot more than last year's group, but occasionally a little lazy and really chatty in the afternoon (during science and social studies time). There were four students that both Annette and I agreed were very difficult to work with on occasion, and a few others that could be fairly disruptive making the group as a whole challenging to teach, in my opinion. Even so, it was clear to me on many occasions that Annette's classroom represented an island in the stormy seas of the school, for her students and for me.

Peer debriefers

While not participants in the sense that they were in Annette's classroom with us, numerous people served as peer debriefers. These people had expertise in a field important to my study including: elementary art education, elementary science education, and visual arts (specifically painting). Three people, one in each of the fields listed above, agreed to discuss my work in the role of peer debriefer. Debriefings occurred anywhere from two to four times for an hour each. As much as answering questions specific to their expertise, these professionals served as informed sounding boards, often asking me questions and guiding me to find my own answers.

I worked with the art teacher in Annette's school to get critical feedback concerning any art instruction I did in the units. Since I had little formal training as an art educator, this feedback also helped to ensure that I did not disrupt the art education of the students (my work with the art teacher was strongly encouraged by one of my committee members in Art Education). This teacher had worked as a classroom art teacher for many years. In our debriefings, I also sought her perspective of teaching interdisciplinary lessons from the visual arts perspective; one that

was very different from my own background and past studies (almost all with a science education emphasis).

I also sought the feedback of a science education professor with expertise in elementary science education. His help was elicited since I had relatively little practice in teaching elementary science. I had much more experience in teaching secondary science, specifically to high school students.

Specific to the art work I produced during the study, I asked for the feedback of a professional artist and personal friend from my work in the local art scene. His criticism, positive and negative, helped guide me to better use art media to express the experience, especially in rendering people in murals and drawings. His encouragement also gave me needed confidence in creating the paintings.

Phases of study

I worked with Annette to plan and teach three science units in her classroom. The following chart illustrates the three units and other major time periods I spent in Annette's' classroom. For each unit or block of time, I include the central theme or topics taught, dates, and emphasis, or other details on the purposes of my work during that time period. In the far right column, there are thumbnail images of large paintings or murals. I painted each mural to represent a different phase of the study. Descriptions of the murals and more about each phase are included in the chart below.

Table 3.1. The major phases of the study.

Dates	Phase of the Study	Emphasis	Thumbnail of Mural
November 2002-May 2003	Pre-study Planning Phase; No unit taught, I only observed and helped with individual students and small groups	To get to know Annette's teaching and her students. Plan for Unit One.	
June 2003	Unit One – Oceanography – the physics, chemistry, and biology of Marine Ecosystems	I sought to do almost all of the science teaching with minimal help from Annette. Initial, I set out to do a self-study, focusing only on my own growth as a science teacher with Annette as a sounding board/secondary participant. No data was sought that included the students. Only data on myself and Annette were collected.	
July 2003-September 2003	Midstudy Reflection and Planning Phase I; No unit taught. Planning and reflection during the summer. Observation and getting to know the new class of students in September.	I modified the study to include Annette (as co-planner/co-teacher) based on what I perceived to be a catastrophic failure of Unit One. It became clear as we reflected on Unit One in July that I needed Annette. That collaboration became included in my research and guiding questions.	
October 2003	Unit Two – Ocean Animals – emphasis on adaptations that help animals survive in marine habitats	Inclusion of Annette into study as co-planner, co-teacher, and (as much as possible) co-researcher. I worked with a combination of small groups (at the 'art and science table') and whole group, often co-teaching with Annette.	

November 2003	Midstudy Reflection and Planning Phase II; No science unit taught, reflection on Unit Two and co-planning for Unit Three	We looked at what we perceived worked and what didn't work to plan for the next unit, on a subject we had not taught together before, Geology.	
December 2003 – January 2004	Unit Three - Landforms (including rocks and minerals, plate tectonics and faults, and landforms specific to our state)	Co-planning, co-teaching, and co-reflection... I worked mostly with small groups (at the 'art and science table') and less (than Unit Two) with the whole group, when I did, it was co-teaching with Annette. We (the students, Annette and I) spend a lot of time preparing for an Exhibition of Art and Science – in which the class came to the College of Education for an opening reception (1/16/04). The students' art work, as well as my own 'research art' at hung at the college through the spring semester, 2004.	
January 2004- April 2005	Analysis and Writing Phase	Data analysis/writing.	

Mural One: My proposal

Mural One (Figure 3.6 below) represents the conceptualization of my entire study prior to any data collection. It was painted while I prepared my prospectus for this study. Based on the sketch I did in March 2002, mural one was done with acrylic paint on a large wood panel (3x5feet).



Figure 3.6. At left is the preliminary sketch that was painted as Mural 1 at the right.

The central figure in blue portrays me as I look through my framed hands at figures sitting around a table. The largest figure (in green) at the table is me, working with five young students. At that point, I thought I would be doing a self-study and would only focus on myself (further represented by the mirror attached to the corner of the yellow board above the central figure). Annette is no where to be found on the painting. At the table there are also art and science materials. At the orange table in the foreground are texts that represent the literature and sources I used to build my theoretical framework. In the bottom right corner, a purple table holds the paints – this represents my methods, as does the paintbrush held in my mouth. Above the yellow board are small scenes representing past experiences that influence the study. Finally, the

yellow board symbolizes my research reports, including findings. It is blank, representing the fact that my study had not yet begun.

Mural Two: ‘Annette, what happened in Unit One?’

The second large painting I did symbolized my efforts to make sense of what happened in unit one, where I tried to do everything with respect to both planning and instruction.



Figure 3.7. Mural Two showing unit one and our reflection on that unit.

Annette entered the scene in two places. At the far right, she (in red) was shown pointing to one of the white squares at the top of the painting. Those three white squares represented calendar months and our plans for units two and three. Annette was also holding up one finger, illustrating her claim that we needed to teach fewer concepts for longer periods of time (‘less is more’). With one hand holding a stick that also pointed to that future month, I was shown in the center in green with my other hand open, expressing my frustration with what happened during unit one.

Unit one is represented in the scene within the gold frame (rectangle). In that scene, I am again featured in a puzzled pose next to a pile of trash that represents all the art materials that I believed went to waste in unit one. Annette, again in red, was shown ‘getting things done,’ instructing students what to do in the right of the framed scene. At the far left of mural two is all the art and science materials as well as the incomplete art projects the students did piled in stacks representing the mess I thought I had made of the first teaching phase of the study.

The overall style of the mural is very loose with striking colors and rough edges. This was done on purpose to represent the chaotic experience as I perceived it. Furthermore, the painting is very busy, with the lower half of it including many forms, lines, colors, and tones. So much happened and I struggled to make sense of it. Annette did not appear in mural one because I thought I didn’t need her. She makes two appearances in this second mural and was crucial to making the experience into a productive one as we planned for units two and three. Our plans, represented across the top of the painting are not as chaotic as what was painted below them, and also not as ‘finished.’ For example, at the top left of the painting is a small scene of our writing group (Annette, myself, and a third Ph.D. student) and a rough sketch of da Vinci’s ideal anatomical man – representing my vision of the union between science and art. This union was not achieved in the chaos that accompanied unit one.

Mural Three: Ocean Animals at the ‘Art and Science’ Table in Unit Two

The third mural (Figure 3.8 below) represents one moment where I did feel that the union between art and science was achieved. The focus of this painting was on two students engaged in an art and science activity. I was sitting with them at the table and Annette is in the background, both of us not in focus. The students were sitting at the ‘art and science table,’ a place where I worked with small groups of students – this was the result of Annette and I looking at how I

could better teach the students (compared with trying to do whole group instruction in unit one). It could be argued that the painting, done painstakingly in oils, remains unfinished. I still have yet to decide that myself – I enjoy the focus on the students and ‘their focus,’ but want to suggest more of their surroundings.



Figure 3.8. Two students drawing marine animal specimens.

Mural Four: The landforms unit and art reception

Mural Four (Figure 3.9 below) shares some important similarities as well as distinctive contrasts from Mural Three. Even more so, Mural Four appears unfinished. In this case, it is indeed not complete. But just as its oil-based sister above, there is value in the simplicity of this unfinished ink and watercolor painting. Unlike the two students in Mural Three, there are many figures in each of the four ‘scenes’ that together form a complex and loosely connected composition.



Figure 3.9. Teaching unit three and the culminating art and science exhibition

One of the unifying traits is the orange and purple combination that is my shirt and hair respectively. Rendered in all four events, I felt like a person that needed to be in four places in one time. In fact, I started the painting in the top left corner by placing my own figure in four different positions at the ‘art and science table.’ Even with only five students, it still seemed like I was trying to do four things simultaneously, whether it was answering questions or demonstrating with the brush, or my desire to paint *with* the students (the ‘Jamie’ second from the left). Annette is writing ‘Geology’ on the flipchart on the other side of the room, talking about the science concepts with the students sitting on the carpet.

Turning to the scene at the top center, I am sitting with Annette at recess. I’m focused on our conversation with my field journal sketchbook in my left hand. Annette also seems engaged

in the conversation; but the many figures at the basketball court in the background are meant to illustrate my point that she has multiple roles to play.

At the top on the right, three figures are rendered in decreasing detail and size from left to right. They are Jamie, Jim (Annette's husband) and Katie (my wife) respectively. We are busy in my art studio at home framing the students' art work in preparation for the show. Spanning the entire lower half of the composition, the opening reception for the art and science exhibition includes many figures. At the center, pointing to a green portrait done in profile I tell a story to students and university partners.

Mural Five: Writing it up

The last phase has had the distinction of being both the longest (from February, 2004 to the present) and by far the least fun of the five phases of this study. The central figures (see figure 3.10 below) represent me again, and like the multiplicity of selves at the 'art and science' table in Mural Four, I look in three different directions. Since this is rarely discussed in most dissertation studies and doesn't relate directly to my guiding questions, I add only one explanation – what is represented by the two female figures that frame Mural Five?

The figure at the far right, my advisor, is getting my full attention (at least the attention of the 'smiling Jamie' on the right). While Deborah deserves much more from me, I point this interaction out as a contrast to the figure at the far left, representing Annette. She has neither my eye contact nor access to my laptop screen. Even though I am eternally *writing* about collaborating with Annette, we were no longer actually collaborating. Not by choice, but by the limitations of this phase of the study. Indeed, her figure represents my struggle to decide how and when to 'add her voice' without getting the opportunity to really hear it in 'real time.'



Figure 3.10. Mural Five: I sit at my laptop, writing it up.

Data Sources

Since this was a naturalistic arts-based inquiry, the nature of my data sources was open to my own talents as an artist-researcher. In addition, more traditional data were collected; for example, interviews and their transcriptions. Due to the large number of data sources sought and collected in the study, I found it helpful to distinguish between primary and secondary sources. The following chart (Table 3.2) organizes all the data sources into four types, signifies whether they were primary or secondary (bold for primary, italic for secondary), and denotes to what extent they were important in answering the research questions.

Table 3.2 Matrix of questions and data sources

Data Sources →	Journals:				Audiotapes:			Archival data:			Visual Data:		
Bold = primary data sources <i>italic = secondary data sources</i>	Field Journal	Dialog Journal	Audio Journal	<i>Art Journal</i>	<i>Peer debrief-ings</i>	Interactions with Annette	Classroom interactions	<i>Student work</i>	<i>Lesson and Unit plans</i>	<i>Partnership documents</i>	<i>Students Artwork</i>	My drawings and paintings, including Methodological murals	Digital photos
Overarching Research Question: What happens when a teacher uses the visual arts to teach elementary school science?	X	X	X	X	X	X	X	X	X	X	X	X	X
Guiding Question 1: 1. What facilitates and constrains the development and implementation of units centered on the visual arts to teach and learn science?	X	X	X	X	X	X	X	X	X		X	X	X
Subquestion 1: How do I conceptualize the relationship between curriculum and teaching? How does this change through the course of the study (if any)?	X	X	X			X	X		X			X	
Guiding Question 2: 2. How do teachers collaborate to plan and implement arts-based science units?	X	X	X	X	X	X	X					X	X
Subquestion 2: How do my perceptions and experiences of the planning and teaching of the units compare with those of the classroom teacher and students?		X				X		X			X		

Primary data sources

Three types of journals were primary data sources. In field journals, I recorded ideas and thoughts in words and drawings. I also did a lot of field sketching of students in those journals, often while observing in Annette's classroom. Another type of journal I considered a primary source was the dialog journal Annette and I shared. In this journal, we engaged in conversations by writing entries a few times each week over the course of the study. Photographs were sometimes pasted into our dialog journal, and we both did some drawings in it. Many questions from both of us were posed and discussed concerning the nature of the study, our respective roles, and specifics related to the research purpose and questions.

The final 'journal' considered primary was my audio journal. This journal was not written but tape-recorded. Almost everyday during the course of the study, I spoke into a microcassette recorder in an effort to remember my thoughts and questions. I reflected on everything related to the research experience, especially after each teaching day so that I would have a record of how I felt and what I was thinking during the experience. I also used the audio-journal to think about methodological issues and tensions.

Other audio recordings I considered to be primary to answering my research questions consisted of interviews with Annette, including semi-structured interviews and conversations. Semi-structured interviews were transcribed in full. Conversational interviews occurred daily during lunch, recess and afterschool. I listened to each of these interviews a number of times, keeping a log of subjects discussed, and excerpting dialog especially relevant to answering the research questions. In a similar way, classroom interactions were recorded and collected. I kept the micro-cassette recorder in my pocket while Annette and/or I taught/interacted with the

students. These interactions were documented in the same way the conversational interviews were (listened to, logged, and excerpted).

My artwork also was a primary data source. These works included 1) large paintings depicting the different phases of the study and especially methodological issues specific to each phase (shown in the figures of murals above), 2) my field drawings of Annette and the students, and 3) digital photos of all aspects of the study, but especially of interactions between myself, Annette, and/or the students. Digital photos were taken primarily by myself, using a very small camera attached to my shirt pocket. Annette took photos of me when I taught the whole group. Jim Randolph, a part-time photographer (and Annette's husband) also took digital photos. I encouraged Jim to take artistic photographs of interactions between Annette, the students, and myself.

Secondary data sources

Secondary data sources were defined as less important to answering the research questions than primary data sources. Instead, these data provide support and context for the primary data sources and include a number of different materials. My art journal is one of these secondary sources; it is a place where I reflected by creating drawings. I also did preliminary sketches for the murals in my art journal and recorded ideas, questions, and changes specific to those murals. Another secondary data source was peer debriefings, where I conversed with experts in fields such as elementary science education, painting, and elementary art education. These recordings were documented in the same way as the conversational interviews and classroom interactions (listened to multiple times, logged, and excerpted as needed). Archival data deemed secondary included lesson and unit plans, that were generated by myself and Annette. Other archival data included partnership documents, like information from websites,

research proposals, and documents from other researchers working at the elementary school. Students' artwork was another form of archival data and also was minor to answering the research questions. It included watercolor paintings, and pencil and charcoal drawings.

In the next section, I briefly discuss procedures of the study in terms of how Annette and I co-planned, co-taught, and co-reflected.

Procedures

This was a naturalistic study. That is, I entered Annette's classroom to explore how interdisciplinary curricula could be best taught. I sought to do the best job possible to teach the students science using the visual arts. As discussed above, the teaching became very collaborative for a number of reasons: 1) the most important thing about my work was teaching the students – after unit one, it was clear that I needed to work very closely with Annette to do a better job teaching students, 2) working together allowed both Annette and I to see and understand what we wouldn't have alone, 3) Annette and I worked hard to communicate and negotiate roles and goals so that we could help each other experience success in our respective efforts, and 4) the need for exploring ways university researchers like myself could productively work in partnership with classroom teachers like Annette was clearly a great subject for research and worthy of expanding my initial purpose to include collaboration.

The procedures used to plan, implement and reflect actually changed over the course of the study. In unit one, I gathered ideas and materials into the rough framework of a unit plan and met with Annette in two fairly formal meetings that were also seen as semi-structured interviews. During the teaching of unit one, Annette and I would reflect on each day's lesson and discuss plans for the coming days during lunch. I would return home everyday and type up lesson plans as well as reflect on what happened with the students and in my conversations with Annette. It

became clear that I would need to record those conversations because much of the decisions and negotiations were occurring in those informal discussions instead of the few formal interviews. Teaching that first unit involved Annette transitioning the students from their regular routine to my 'guest teaching' lessons. As the unit concluded, Annette took a more active role in facilitating discussions and clarifying directions as I became less comfortable with those tasks. In July, Annette and I sat down for 90 minutes to reflect on what happened with the intention of looking at what worked and didn't so we could plan the remaining units that would be taught in October and December. At that meeting, Annette took a much more active role in the collaboration upon my explicit request and unconscious realization that I had no choice but to work much more closely with Annette.

As a result, co-planning, co-teaching, and co-reflecting were much more successful for units two and three. In similar, but more extensive ways in terms of time and energy, Annette and I met before and after our lessons, during lunch and recess and afterschool. We specifically sought ways I could work with small numbers of students at an art and science table in the back corner of her room. Students rotated in and out of that table so that I only had 2-6 students at a time, usually for around 30 minutes each. Annette led the rest of the students (those not at my table) either as a whole group or in a number of other activities where they worked in small groups. Lesson plans were altered, added, or deleted from unit plans depending on our daily meetings in which we reflected upon the previous lessons. Semi-structured interviews were held between and after units but became more open, candid and two-way, especially compared with the first interview where I asked Annette questions from a list.

Data Analysis and Representation

The strengths of arts-based narrative inquiry as a methodology include an openness to artistic and creative forms of research, especially representation. However, in welcoming teacher-researchers to utilize their own personal strengths and just about any form of meaning making or human knowledge, Diamond and Mullen (1999) provide little prescriptive guidance for how to go about analysis within an arts-based narrative inquiry, as illustrated in the following quote:

As arts-based researchers, then, we do not presume to produce works of ‘capital A-Art’ or to satisfy some abstract, logocentric criteria. Instead, we show how everyone can shape experience by using the artistic forms of elaboration (super-adding) or economy (imaginative omission) (p. 26).

In his text on qualitative research titled *The Enlightened Eye* (1991), Elliott Eisner also gives little prescriptive advice or details for specific procedures on data analysis. At the same time however, Eisner provides a good explanation for why he can not do this. For example, researchers, novice and experienced alike, should work to utilize their own unique talents and gifts in their studies. Eisner notes, “Qualitative inquiry places a high premium on the idiosyncratic, on the exploitation of the researcher’s unique strengths, rather than on standardization and uniformity” (p. 169). Furthermore, according to Eisner, “There are no routines to prescribe, no rules to direct one’s steps, no algorithms to calculate. There are desires, flexible aims, and the need to remain in touch with what’s important” (p. 170). In validating a more complex and fluid set of processes, I found this absence of step-by-step procedures both daunting and liberating as I proposed how I would analyze data in the spring of 2003, and then actually did that analysis in the Spring of 2004.

What I found in Diamond and Mullen (1999) and Eisner (1991) was encouragement to find and use my strengths and talents and the freedom to develop fluid and complex ways to make sense of the data that resulted from methods emphasizing those gifts. For more specific support and guidance on how to analyze my data, I was influenced by four strands of educational research related to arts-based narrative inquiry: narrative research (Clandinin and Connelly, 2000; Polkinghorne, 1995), arts-based educational research (Barone & Eisner, 1997), Wertsch's (2002) notions of specific narratives and schematic narrative templates, and finally, teacher cases (Tippins, Koballa, and Payne, 2002; Koballa & Tippins, 2004).

Analysis in the field

While in the field, I sought to collect as much data as possible and predict my future data needs. In addition, I deliberately tried to make sense of what happened as or soon after it happened. In other words, I attempted to analyze while I collected data and to think about what data I would collect in the future. This process of ongoing analysis is consistent with participatory action research, where data collection and analysis become blurred with the methods and findings. A researcher-teacher is trying to improve his or her practice and the research methods go hand in hand with understanding and improving that practice, as that practice is occurring. The ways we 'research' our practice are part of what we seek to research. Therefore, analysis during data collection was extremely important and due to the complexity of the research experience, had to be fluid and naturalistic. Conversations between Annette and I were critical to that process. The dialog journal allowed Annette and I another way to thoughtfully reflect on and communicate our ideas on how to improve our instruction and the collaboration. Other things were specific to my own process of sense making, like audio-journaling and art making.

Data organization and tidying

Before describing how I engaged in data analysis that was specifically narrative research, Clandinin & Connelly (2000) claim the first goal must be to inventory the data collection, with an emphasis on sorting through all of the data, labeling and dating it, and placing it into folders (either computer folders or manila file folders). Lists were generated that included dates collected, descriptors of the datum and how the data was collected and organized in this phase (see appendix for examples of lists of audiotapes and journals). For example, all of the records of thoughts, changes, and additions to each of the research murals were combined into one ‘chronicle.’

The following graphic organizer (see Figure 3.11 below) is a simplified version of the three main phases of data analysis which include analysis of narratives, narrative analysis, and cross-case analysis and two main resulting narratives: specific narratives and schematic narrative templates.

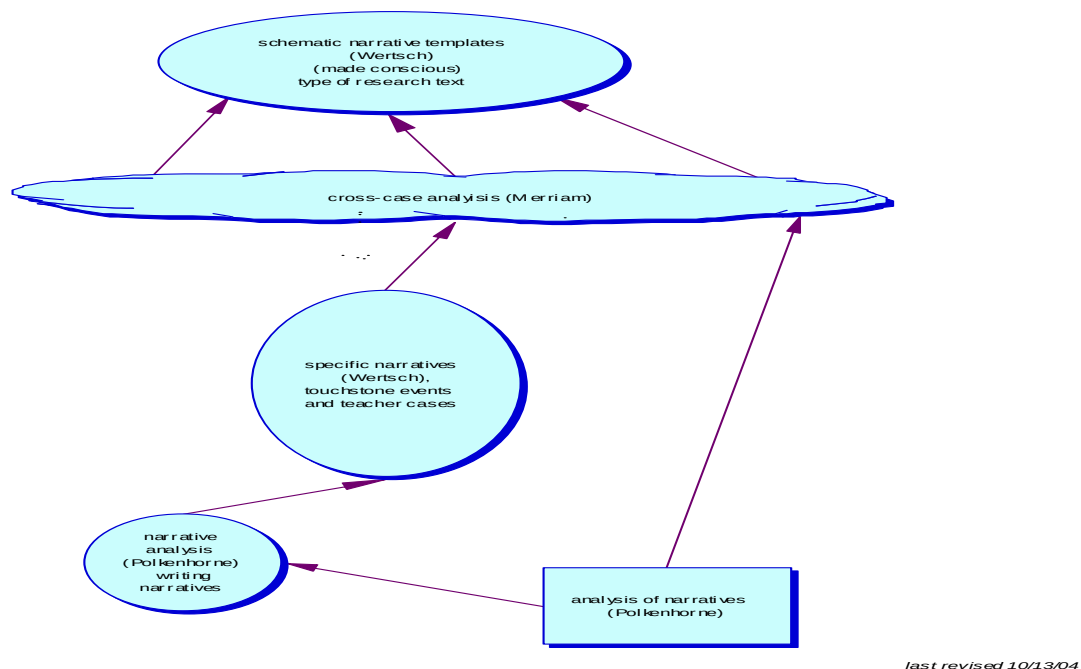


Figure 3.11. A version of my data analysis scheme in the form of a graphic organizer.

Analysis of narratives

Once I sorted and labeled all the data, I engaged in what Polkinghorne (1995) described as an effort to “locate common themes or conceptual manifestations among the stories collected as data” (p. 13). This process, as I saw it, was quite similar to doing inductive analysis, a process common to many types of qualitative educational research in terms of the following steps: ‘reading’ the data, coding the data, developing categories for the codes, and developing themes that reflect the categories.

Reading the data meant different things depending on the type of data. All data is deemed as narrative according to Clandinin and Connelly (2000) who refer to raw data as “field texts” (p. 116). In my study, these data stories or field texts took the form of audio-taped conversations, self-reflection, and classroom interactions, images that included my drawings and paintings as well as digital photographs, archival data including lesson and unit plans. It is sufficient to say that my field texts included much more than interview transcripts and field notes. Therefore, I could not micro-analyze the texts. For instance, with the sheer volume of audiotape data (over 100 hours) and digital photographs (over 1000 photos), it was not necessary to transcribe every word of all the tapes (although in the case of the semi-structured interviews, that was done) or describe (or code) all aspects of every photo.

One of the ways I kept track of so much data was by keeping data logs. These logs were lists that summarized in a few words how I viewed much of the data. Furthermore, the analysis of narratives I engaged in depended on the type of data. For example, visual data was looked at and saved as computer files with one-three word labels. Images deemed especially valuable were copied and placed in computer folders where they were ‘coded’ – I printed each out and wrote ideas, questions, and memos with arrows and circles to different parts of the picture. In addition,

I continued to view field texts throughout my data analysis and writing process, namely, looking at images and listening to audiotapes.

As I moved from reading the field texts, to coding, I kept in mind that my goal was to generate tensions that explained and framed the research experience, especially in terms of my research questions. Therefore, while reading and coding, I started to compile a list of preliminary tensions. While I did not explicitly seek to find evidence for each tension as I read and reread the field texts in the coding process, I occasionally returned to my tensions list and sometimes copied and pasted transcript excerpts, images, or other data that I believed supported or refuted those tensions.

By *tensions*, I mean to denote themes that affect the experiences in multiple and complex ways. Tensions are often seen in negative terms...to be avoided or resolved. I used the term to designate broader educational phenomena and that could be positive or essential to effective teaching or appropriate classroom learning (Arellano, Barcenal, Bilbao, Castellano, Nichols, & Tippins, 2001; Tippins, Nichols, & Wieseaman, 1997). From my perspective, seeking resolution to tensions is not necessarily the goal; instead, what is most important is recognizing the complexities within the tensions and seeking to understand how we can best work within the constraints of those tensions. In other words, exploring and explicating tensions meant seeking heightened alertness or critical consciousness concerning the research experiences, not glossing them over with evidence of solutions and resolutions.

In an example prominent in the history of science, Thomas Kuhn (1977) refers to tensions in positive terms as paradigm shifts that require the pull between following tradition and breaking from that tradition. The following is an excerpt from his essay, "The essential tension: Tradition and innovation in scientific research" (Kuhn, 1977):

...only investigations firmly rooted in the contemporary scientific tradition are likely to break that tradition and give rise to a new one. That is why I speak of an ‘essential tension’ implicit in scientific research. To do his job the scientist must undertake a complex set of intellectual and manipulative commitments. Yet his claim to fame, if he has the talent and good luck to gain one, may finally rest upon his ability to abandon this net of commitments in favor of another of his own invention. Very often the successful scientist must simultaneously display the characteristics of the traditionalist and of the iconoclast (p. 227).

These opposing views, according to Kuhn, meet in the place that is most productive. In Kuhn’s example, if the scientist is only in ‘tradition,’ then nothing changes. If, however, that scientist is only in his/her own invention then his/her work will be ignored. Thus, he/she must work within an invention yet to be firmly rooted in the tradition (that invention breaks from).

In the same way, an effective teacher must often work within in two opposing pressures. For example, he/she must keep the students’ interests in mind while balancing the requirements of the mandated curriculum. To ignore one for the other is not productive in either case. However, to recognize the tension allows that teacher to seek places within these tensions where quality teaching and learning can occur. In the next section, I discuss specific narratives, or stories revolving around one or more tensions.

Narrative analysis

According to Polkinghorne (1995), when one writes stories, that is, engage in narrative analysis, he/she seeks to create “a coherent developmental account” (p. 15) of a research experience through a synthesis of the data collected, or field texts (Clandinin & Connelly, 2000). Bruner’s (1986) narrative way of knowing supports the notion of generating and revising stories

as an appropriate form of analysis. In this study, I combined the smaller stories, generated in part through the analysis of narratives, into longer accounts using the research questions to maintain needed focus. The result of this narrative analysis was specific narratives (Wertsch, 2002). In the next section, I discuss the characteristics of two main types of specific narratives, teacher cases and touchstone events.

Specific Narratives

Wertsch (2002) claims there are two important categories to consider when studying narratives: specific narratives and schematic narrative templates. I discuss the latter below. The former, specific narratives are what we typically associate with the notion of stories – those texts with a coherent beginning, middle, and ending that center on a plot and include characters and events (Wertsch, 2002). Initially, my goal for narrative analysis was to generate a particular type of specific narrative, known as teacher cases. It became clear in the process of creating and revising these teacher cases that I needed another brand of specific narrative, for which I use the title *touchstone events*. These stories introduce and conclude the teacher cases, together of which are contained in Chapter Four. Their properties are described below.

Teacher cases

Teacher cases form the core of the findings of my dissertation. These stories are examples of the “narrative mode of literature” (Tippins, Koballa, & Payne, 2002, p. 6). As types of specific narratives, teacher cases portray teachers, students and other characters and revolve around a classroom occurrence. Typically, teacher cases are used to instigate and facilitate discussions, often in teacher education classes. In my own teacher cases, the stories revolve around tensions, a notion very similar to dilemmas.

Two types of teacher cases are open cases and closed cases. Those narratives that leave readers to generate solutions and decide on their own resolutions are open cases. Conversely, closed cases are stories in which the author provides a solution to the dilemma or tension in the story. Like most categories, there is a continuum between open and closed cases. However, my goal was not so much to ‘resolve’ tensions as to understand them and try to figure out how to work productively within those tensions. Therefore, the teacher cases I wrote and included in Chapter Four lean towards open cases. Furthermore, Tippins, et al. (2002) believe no case is ever really closed – this notion fits with my methodological perspective, that cases (or any narratives for that matter) should raise more questions than they answer.

As I started to write each case (explicitly as a case), I reviewed Tippins’, et al. (2002) section on case writing, which contains the following passage:

writing a case provides an opportunity for you to further define and explore a dilemma of your own choosing...the writing process will provide you with practice in framing and interpreting problematic classroom events...the experience can serve as a powerful tool for organizing your thoughts in the face of uncertainty. Your written case can become a stored record that you can visit and revisit as new information becomes available (p. 208).

In all of the ways stated above, writing cases has helped me in this study and was a powerful analysis tool as well as a mode for data representation (see Chapter Four).

Questions for reflection

The questions at the end of each case are modeled a casebooks. In casebooks, the usual purpose of reflective questions is to help readers focus on the tensions in the case and spark thoughts and ideas on how the narrative relates to their own beliefs and experiences. In the same

way, these questions are meant to do that for readers here. And in the same way that the questions work in casebooks, these questions will also point readers to what I believe is most important...that is, what I hope they *take* from the story.

Touchstone event narratives

The second type of specific narrative used to analyze and represent data in the study was touchstone event narratives or simply touchstone events (Edelsky & Johnson 2004). *Touchstones* are tests of quality, to see goodness or richness. I first heard the word *touchstone event* from a qualitative writing instructor and educational researcher who was reading one of my interim teacher cases (Allen, 2004, personal communication). After reading an early draft of what would become the first story in my findings section, she noted that it was not a teacher case in which the dilemma was put forth and central to the story. Instead, the story set up many of the major tensions in that it provided a needed context in which to place those tensions. Indeed, it provided that test of quality in which to view the teacher cases.

As used in this study, touchstone events are indeed very special stories or anecdotes. Edelsky and Johnson (2004) use the term to describe actual examples in an elementary school classroom that support their claims about critical whole language practice. Their touchstone events, like the ones I describe, were enacted in a particular space and time. In Chapter Four, I include two touchstone event narratives that occurred at two critical points in my study. As such, the first introduces the teacher cases; the summative event concludes those cases by sharing the story of the culminating event of my work with Annette. That event provides some resolution to my wrestling with the tensions in the teacher cases before the last narrative.

Dialectic between Analysis of narratives (analysis of the field texts) and Narrative analysis (writing/revising the specific narratives)

I wrote the cases and touchstone event narratives during and after my analysis of narratives. The dialectic between coding the field texts and writing and revising the stories fit with the notion of interim texts (Clandinin and Connelly, 2000). Both my stories and any resulting texts from the analysis of narratives (for example, a list of preliminary tensions with supporting evidence from the field texts for each tension) are interim texts. And these interim texts were written interchangeably. In other words, I went back and forth chronologically (when I did analysis of narratives and narrative analysis, or writing the stories) and in terms of the content and focus – that is, after listening to a large amount of audiotapes, I wrote a story; after writing the first draft of that story, I looked at a series of digital photographs and field journals and listened to more audiotapes. I engaged in each task depending on how comfortable I was in ‘knowing’ the field texts versus how comfortable I felt writing stories based on those field texts.

The notion that writing can be used as a form and method of analysis is supported by Ely, Vinz, Anzul, and Downing (1997) in their text *On Writing Qualitative Research: Living by Words*. As described above, I refer to the process of generating and revising stories of my experience as I comb through the ‘raw data’ or field texts generated from that experience. This fits with Ely’s (et al. 1997) conception of “writing our way towards understanding (p. 27).

The specific narratives comprise part of my ‘research texts’ (Clandinin & Connelly, 2000). According to Clandinin and Connelly (2000), research texts are the ‘final versions’ of the stories’ narrative process (beginning with field texts and then interim texts). Research texts, are the result of analysis; they are also the resulting representation. In terms of my touchstone

events and teacher cases, these research texts are my best attempt to represent the research experience, that is, the findings of my study...in part.

Above, I have reviewed how I view the generation and revision of specific narratives as both data analysis and representation. In the next section I discuss schematic narrative templates. These texts represent an additional level of analysis to specific narratives, and particularly reflect the discussion of the findings.

Numerous people had an impact on the study in the arena of supporting my analysis of the data by providing feedback on my writing. Writing as a form of analysis enabled me to take directions and come to numerous realizations that I would not have developed otherwise. These learning events occurred in the process of writing itself, as well as getting feedback on my writing during the course of the study. I was fortunate to participate in two separate writing groups, both the direct result of two separate week-long writing workshops.

The most influential relationship I have had in terms of inquiry and analysis through writing was the one between myself and my advisor. Her feedback and criticism facilitated my sense-making process and products to a large degree and we sought to use writing not just to represent my study but also to make sense of the experience during and after that research experience.

Schematic Narrative Templates

Wertsch (2002) describes schematic narrative templates as having “generalized functions that characterize a broad range of narratives...[that share]...recurrent constants” (p. 60) across specific narratives. These narrative templates are *schematic* in the sense that they concern abstract, generalized functions. Wertsch explains that the notion of template is involved because

these abstract structures can underlie several different specific narratives, each of which has a particular setting, cast of characters, dates, and so forth.

Schematic narrative templates are culturally specific or “not readily available to consciousness” (Wertsch, 2002, p. 62). Since I was primarily interested in the ways both Annette and I made sense of our teaching experiences, this posed a problem – this notion that the ways one make sense of experience through story were, at first, not easy for me to *see*. While inherently problematic in any study where the researcher aims his lens on himself (Bullough & Pinnegar, 2001), I discuss below the process I engaged in to see what otherwise was not ‘readily’ seen.

Cross-story analysis

To find these schematic narrative templates, I compared the stories and touchstone events to each other and to interim narratives (for example, all the memos written during analysis; another example of interim texts are any stories that did not make the final research report). The effort was to do what Merriam (1998) attempt to do in *cross-case analysis*, to find patterns within the cases and across the events.

My process of cross-story analysis is analogous to cross-case analysis in that it shares many similarities but is fundamentally different in the following ways: Merriam (1998) refer to cases not as teacher cases, but as ‘cases’ are more commonly used in educational research – the idea of distinct and connected topics of considerable complexity, whether it be an organization, one person, or a series of related events.

Returning to the similarities between cross-case analysis and my own final stage of analysis, it was the research questions that provided the focus to look across the cases for patterns. As I read and reread the stories and interim texts, I sought to find both similarities and

differences across the texts that related to my questions. I related those things to past literature and also framed them within my theoretical perspective. The result of which was what Wertsch describes as schematic narrative templates. The diagram below (Figure 3.12) is an extended version of the initial diagram depicted in the previous figure (Figure 3.11) and includes the many steps and resulting texts/narratives.

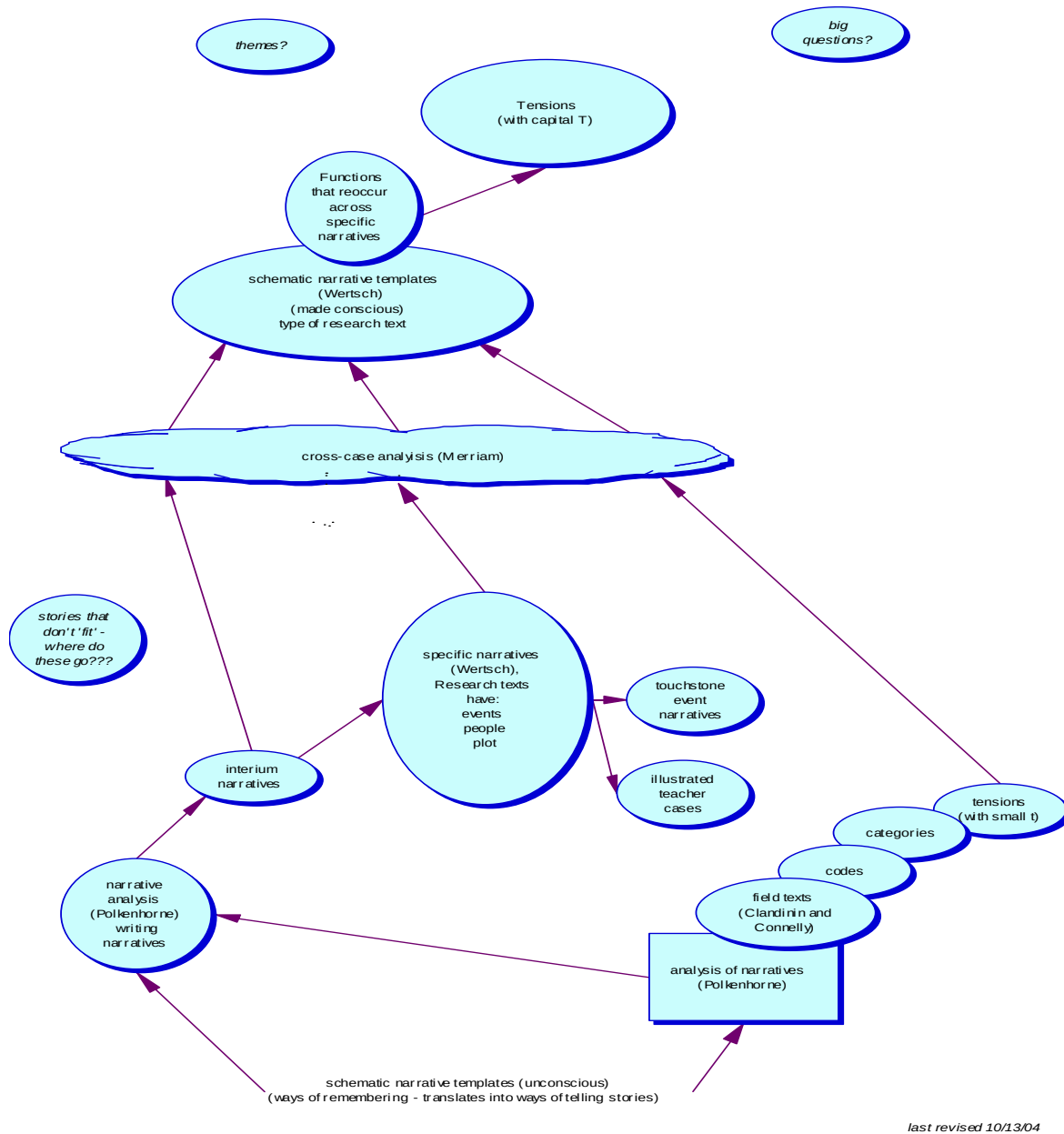


Figure 3.12. An extended version of my data analysis plan using Inspiration®.

Visuals and drawings as narratives

In order to use my (and my other participants') talents in the visual arts to further make sense of and represent experience, I found expanded definitions in the literature of what counts as narratives. In his book, *Visual Methods in Social Research*, Banks (2001) defines visuals as narratives. Specifically, he was referring to photographs. Gallas (1994) extends the definition of narratives to include drawings and paintings by citing Bahktin's notion of narrative as any complex set of symbols. In this study, I used visuals in conjunction with texts in an effort to use my unique gifts and talents as a researcher (Eisner, 1997).

Three Criteria for Judging the Quality of this Study

It is important to define how this study and particularly its findings (the specific narratives and schematic narrative templates) can be judged for quality. I extend Eisner's (1991) criteria as standards by which this study should be evaluated. The first criterion is *coherence* in which a narrative is judged to be believable or not. Two telling questions include, "Does the story make sense? [And] How have conclusions been supported?" (p. 53). In addition, multiple data sources tend to lead to greater coherence.

Consensus is the second factor. It includes two related forms, consensus among readers that the findings agree with 1) the evidence presented within the research, and/or 2) their own experiences. Eisner (1991) points out that persuasion, therefore, is important since consensus is a matter of agreement. The third and according to Eisner, most important criteria is *instrumental utility*. This last factor helps the reader to judge work on the basis of whether it is useful in both comprehension and anticipation (of the future).

A Note about Subjectivities and Conclusions

Before concluding Chapter Three, I thought it prudent to explain why I do not include a Subjectivities Section, typically done near the end of methodology chapters in qualitative dissertations (e.g. Brandt, 2004). Indeed, my subjectivities could in no way be limited to one section (especially in this chapter); rather, they are woven throughout the entire study and made especially explicit in the following chapters. Arts-based narrative inquiries, including this study, often are explorations of subjectivities themselves, as least as they relate to ones' teaching and work in the classroom (Diamond & Mullen, 1999).

In this chapter, I began with a discussion of my methodological framework, based on Arts-Based Narrative Inquiry, and influenced by the larger and related arenas of narrative research and Arts-Based Educational Research. My specific methods for data collection and analysis were then described. In the next chapter, I apply what has been discussed up until this point in the creation of specific narratives that portray key events and tensions from the study.

CHAPTER FOUR

FINDINGS PART ONE – SPECIFIC NARRATIVES

Introduction

I have not mentioned a fact that I believe that every teacher knows in his or her bones, namely: the teaching of art is about more than the teaching of art. Although we can emphasize in our discussions academic content, artistic forms of learning, and the ways of dealing with accountability, ultimately we are concerned with students and with their overall development as well as their particular development in the arts. I know as a former high school art teacher that some of the most gratifying moments in my teaching life, including the time that I have been at Stanford, were during episodes in my art room in which I touched a student's life or a student touched mine. Such relationships with others, with what is said to them, how they are supported, the vision we help them form of their own possibilities are among the most important things we teach, whether we are teaching art or social studies, whether the subject is mathematics or physics (Eisner, 2001, p. 10).

Elliot Eisner's words speak to me on a very personal level. They point to one of the most important goals I have for this study – to touch students' lives in positive ways, whether it is by art or science or both; or by trying to help the students' classroom teacher. A second goal I deem most important is to learn more about how to teach science using the visual arts and how to do this in the complex setting that is a public school

elementary classroom. In this chapter, I share stories that speak to my successes and failures in meeting these goals. It is my hope that they speak to you on a personal level, to your experiences and your goals.

Research Questions and Tensions

The overarching question for the study is as follows:

What happens when teachers collaborate to plan and implement arts-based science units?

My guiding questions and subquestions for the study are:

- 1) What facilitates and constrains the development and implementation of units centered on the visual arts to teach and learn science?
 - a) How do I conceptualize the relationship between curriculum and teaching?
 - b) How does this change through the course of the study (if any)?
- 2) How do teachers collaborate to plan and implement arts-based science units?
 - a) How do my perceptions and experiences of the planning and teaching of the units compare with those of the classroom teacher and students?
 - b) What facilitates and constrains the collaboration to plan and implement arts-based science units?

I address the questions above by sharing stories of my research experiences. The stories in this chapter are a reply to the above questions; while they represent only a fraction of my experiences, they each incorporate major tensions that weave their way through the whole of my research experiences. As discussed in Chapter Three earlier, the stories take two forms: 1) touchstone events, or stories about a single event that captures

what occurred throughout the study; in this case, the first touchstone event introduces the teacher cases while the second touchstone event concludes the chapter, and 2) teacher cases, revolving around a dilemma or tension intended to represent the complexities of classroom situations in succinct, brief narratives.

The narratives that follow problematize emergent tensions as my ‘issues,’ rather than those of my collaborator, Annette. In the final story, the summative touchstone event, there is some negotiation and resolution to these tensions as illustrated by the culminating event of my data collection in the field – an art exhibition with Annette and her students.

Introductory Touchstone Event – Just look at ‘em!: The ideal moment in connecting art and science learning.

This is a story about one of the touchstone events of my study. A touchstone event is a key occurrence that sheds light on the tensions, themes, and questions that constitute my entire research experience. Touchstone events are not teacher cases in the sense they do not depict a particular tension or dilemma. Instead, these specific narratives, like their namesake, provide a kind of test to contrast the cases and other research texts.

This introductory touchstone event paints a backdrop for the entire study. In other words, its purpose is to introduce all the major tensions that run through the gamut of experiences that make up my work with Annette in collaborating to teach science through art. One of the main tensions this story alludes to is the pull between art teaching/learning and science teaching/learning. However, what follows is an account of one of those ‘perfect teaching moments’ in the sense that the students are doing good art AND good science. It is told from my perspective as I sat with them one October afternoon. In

reality, I did not see this as a ‘perfect moment’ as it occurred. Like so many times in teaching, at that moment I was bombarded with stimuli and worried about all kinds of little things when I photographed these students (see Figure 4.1 below). Luckily, I took the photograph. And as soon as I saw it that evening, I thought, ‘AH HA! This is the picture that represents so much about what I’m trying to do in my research.’ It shows the perfect connection between art and science.

As you look closer at that photograph (Figure 4.1 below) you will notice the blurred image of a figure moving behind the students at the table (in stripes with her head cut off). That is Annette, and she is in charge, working with all the students not sitting at the table in the foreground. The way our roles were negotiated and fulfilled represents another set of tensions important in the study; in this example, there is resolution in that moment...a feeling like, ‘Huh, this is the way a university researcher can collaborate with a classroom teacher to actually co-teach real public school kids.’ In that moment, I was working with a small group while Annette simultaneously taught the rest of the students.

The ideas I reflect on in this narrative are:

- Art and science teaching can sometimes be done well together (interdisciplinary teaching).
- I fit into Annette’s classroom perfectly because: 1) I am working with a small number of students, 2) I have negotiated and changed my role in Annette’s classroom through much work and effort.
- My perceptions of the instructional goals (interdisciplinary teaching), our roles, and the ways they are mediated in the context of the study (for more, see Chapter Five).

In other words, this touchstone event is a great place to start when looking at the major tensions that surrounded our collaboration because it illustrates an event where I perceived that ‘everything worked!’



Figure 4.1: From left to right, Miguel, Jose, Lindsay, Dominic, and Janet (all pseudonyms), sit around my ‘art and science’ table. The teacher, Annette Santana, is pictured top/left of Dominic with the rest of her fifth grade class.

Just look at ‘em! WOW, they ARE doing it!... They are learning science using art. Look at the great science stuff on the table...that’s a whole bottlenose dolphin skull in between the jars with the shark and anchovies. Seated around the table are five students handpicked by Annette as a group that could work together well. And what exactly are they doing so well? Dominic and Lindsay are illustrating perfectly the technique I had just taught them. I had modeled it once in front of all the students and a second time with just that group of five. And I was encouraging and correcting them when I stopped to take that picture. I myself had learned it the same way in my art classes. And they were doing it! – contour drawing, a technique where the artist looks closely at the object and not at their drawing. Lindsay is staring at a bottlenose dolphin vertebra bone, Dominic at a bluefish.

I love it! This is exactly what I set out to do in my dissertation...to learn how to teach science using visual art. Not only that, but I'm working with real kids in a real classroom.

*Hot dog, just look at 'em! This is great art teaching **and** great science teaching. In doing this exercise, we sought to help each fifth grader to focus closely on the specimen, on what he/she's drawing. In doing so, they are meeting some of the QCC's (our statewide science objectives) by doing one of the most important skills in science, observation. Wow, and look at their drawings (see Figure 4.2 below).*

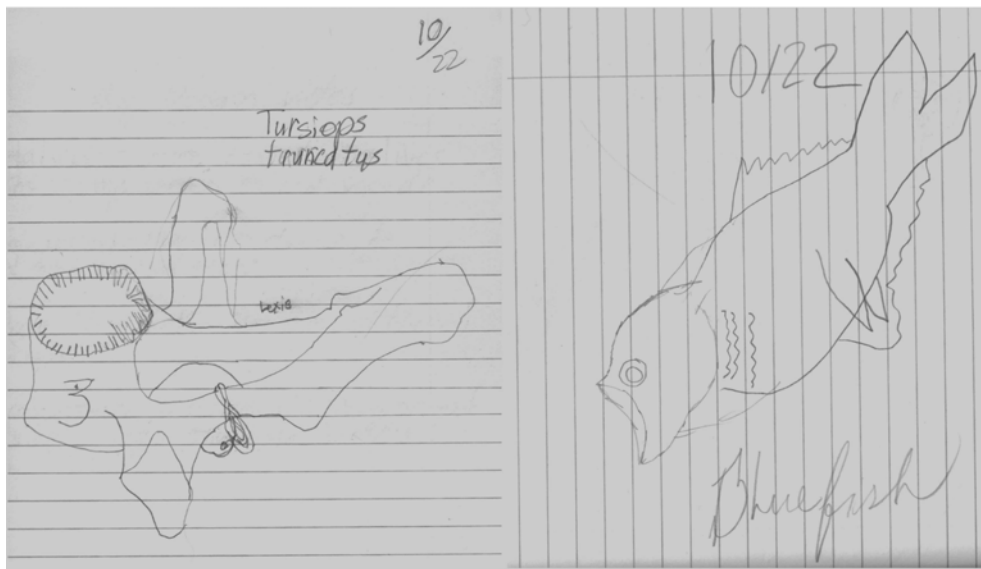


Figure 4.2. Students' contour drawings. Left: Dominic's contour drawing of the bluefish.

Right: Lindsay's contour drawing of the dolphin vertebrae.

These drawings attest to the level of care and observation undertaken by the students. The observation and drawing skill required a lot of focus, but was teachable, as I was taught and as I was now teaching it. It's true that there are only five students at my table; but I got 'em all working. Even Jose, (second for left) who has a severe learning disability, is doing what looks to me like good art and science. I'm spending most of my

time talking about how to do the art technique, reassuring students that their drawings are going to be fine, reminding them to keep looking at their specimens. But lots of great questions come up about the animals they're observing. "Why are their eyes on the same side of their head?," "How does this thing move?," or "Where does this fish live, in the deep ocean?" I'm trying my best to answer their questions in ways they can understand but that lead them to think about adaptations in ocean animals – the topic of our unit. I want them to really look at these animals and I'm hoping it will spark their curiosity and help them want to learn more about them. In addition, I want them to learn how to draw realistically and want to draw more.

So often, fifth graders will draw things in scratchy, tentative lines without really looking at what they're drawing. Worse yet, they say they can't draw, that they're no good at it, that the things they draw are ugly. And drawing is important; it is a skill that can take you a long way. It helps you do good things. Plus it's fun when you finish and you like what you draw because it looks realistic. This perspective is based on my own experience as a local artist. I love creating through drawing and painting, and I'm passionate about it, and I want to share that passion. Yeah, I guess I want the kids to do what I've done, to be a little like me. These goals don't come out of my science education background. They come from my world of art which until only a year ago, was almost completely separate from my world of science education. But in this scene, this view I have right now (Figure 4.1), I see a perfect blending of my once distinct worlds. And I guess what I want most for these five kids in front of me is to find the success, the perks, the prestige and privilege that I've found in my experiences as an artist. For example, when I draw something and it really looks like the object or scene I'm trying to depict,

people often say things like, “Wow, that’s cool! I didn’t know you were an artist! I wish I had that talent!” I would love for all the students to experience that too. Oh, yeah, and I want to teach good science at my little table here.

Buzzing around my table is all other aspects of the learning environment – the twenty plus other students and Annette, taking care of everything else. It’s Annette’s classroom and I’m part of this picture by virtue of our collaboration. And just look at ‘em! What a great world I have – what a blessed way to teach. It’s early in our second unit teaching science together. And it is Annette’s idea that I should work with her students in small groups. In the first science unit we developed together (at the end of last school year), I tried to do everything, even teach all her students at the same time everyday - and it was a flop! I couldn’t give the students much feedback or individual attention, so important in working with people that are not confident in drawing. I felt like the students in that first unit were continuously frustrated and really didn’t learn much science. But now, I can give each student plenty of suggestions and lots of positive feedback. I feel like I’m doing a good job of teaching both science and art.

Just look at ‘em! They are closely observing every line, every edge. That’s exactly what they’re supposed to be doing in contour drawing – to look at the object and not look at what their pencil is doing. Instead, their pencils are ‘doing’ what their eyes are doing – moving slowly and putting lines on their paper that are the same as the lines their eyes are ‘following.’ It forces them to ‘see’ what they want to draw – to better understand how things really look. In this process, they are also forced to observe the specimen very closely. When I think about how I used to do this activity (comparative anatomy of animals) when I was a high school teacher, I had each student record observations for

each animal – that is, write words and statements that described what they were seeing. Often, my high school students would take one brief glance at the animals and record superficial characteristics like color and size. They’d be done ‘observing’ often within a few seconds after they started. But these fifth graders, each one has been really looking, I mean really focusing on one animal for minutes. It’s not the only way to observe, but seems to me it’s one way, one great way – something in their science ‘toolkit,’ and their art toolkit – seeing these kids add to those toolkits...that is so important!

But maybe more important to me, I feel like I’m doing a good job researching - that is, thinking about what I’m learning. My microcassette player is recording in my pocket and my digital camera is flashing away. And what examples I’m seeing – ‘real’ kids doing ‘real’ art exercises using ‘real’ science specimens. And what neat science ‘stuff’ – all the specimens on the table come from science boxes I borrowed from the Georgia Museum of Natural History. Sounds like it’s 100 miles away, but it’s only a block from my office on the university campus.

If only this happened everyday! If only I could see this and take pictures of scenes like this every time I sit down with students. Savor this moment, Jamie, because they don’t come everyday. Not even for university teacher-researchers like me that get to jump in and out of these trenches of the public school classroom with lots of pie-in-the-sky notions of what is possible...and get to leave without being burdened by the daily grind of paperwork, classroom management problems, and all the other things that lead to teacher burnout. Annette even knows I’m worried about having to discipline the students and she was just here, telling Miguel to get back on track. She’s had me in her classroom for months now and I feel right at home, knowing she wants me here and knowing she’s

in control of things. And I don't have to worry about how the students do on their standardized tests...or the principals, parents, or faculty meetings...Annette takes care of all that. I don't even have to worry about grading the work they do here at my table.

Now don't get me wrong, Annette AND I have worked hard to design good science activities in ways that's best for the students...and for us. I've tried really hard to take up as much of the 'teaching load' while not taking up too much of her time...for example, I often sit with her outside during recess and eat lunch with her in the classroom and try not to take up her time afterschool when she wants to go home to her infant daughter. Still, we often talk after school and even on weekends to make sure we discuss best practices and future plans. But I try to make her hectic job a little less hectic. Just yesterday I brought in printer ink and paper so she won't have to walk to the copy room down the hall to print out small items (something that can be a big deal when 25 ten-year-olds are in her care). And I always try to tell her how good of a job she's doing when she feels like she should be doing more...often using the dialog journal we exchange a few times a week (see Figure 4.3 below).

And just like this scene (below) helps me realize I'm doing really doing a good job, the picture above (that I had pasted into the dialog journal) helped Annette do the same.. And I hope I was able to reinforce that in the conversation we had about her entry – how glad I was that she was able to see that and how surprised I was that she felt like she was not doing a great job of teaching – 'Just look at that picture,' I reminded her.

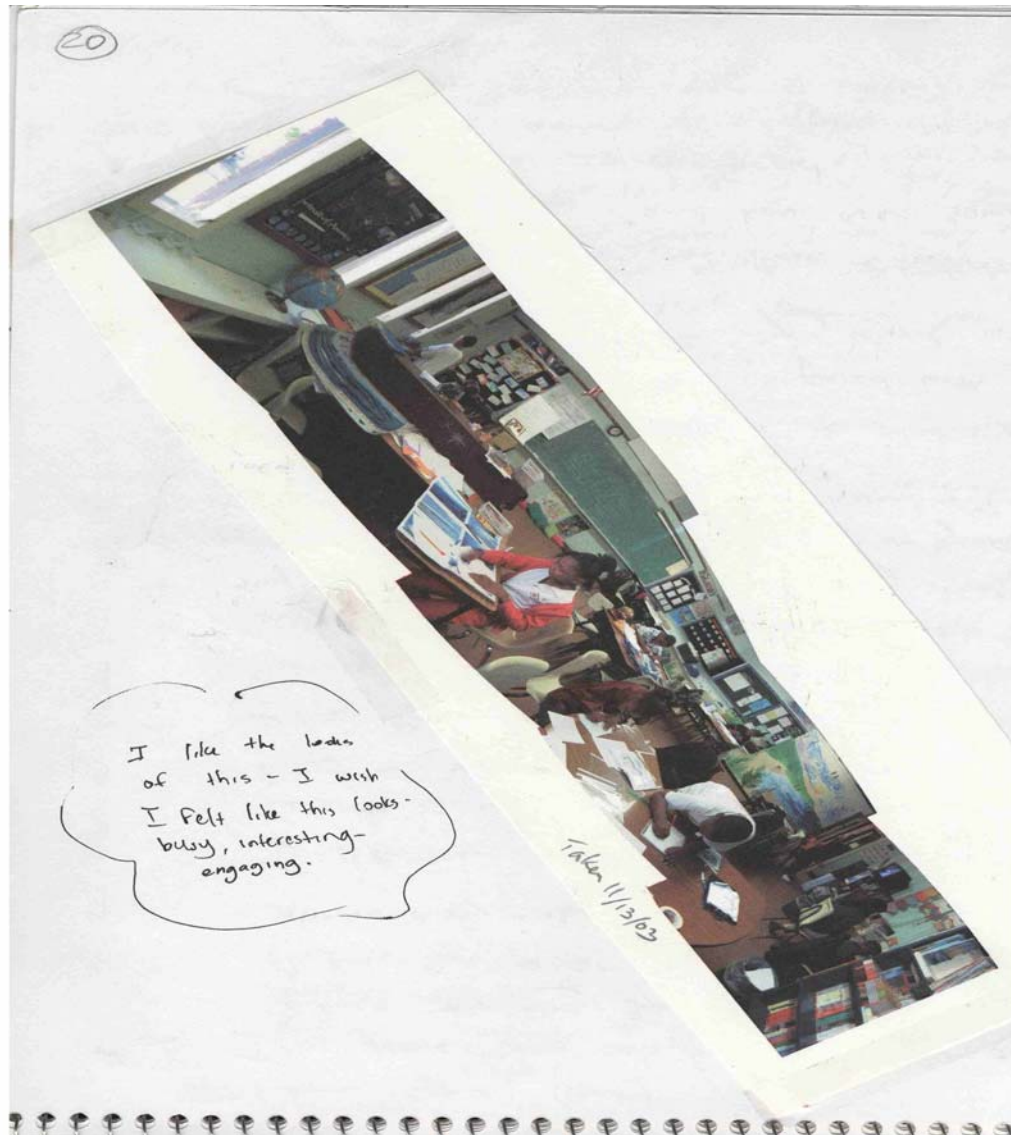


Figure 4.3. An excerpt from our dialog journal in which Annette reflects on how much better the image seems than her perception of her teaching.

*And I can't wait to show her the picture of what's in front of me now. I mean...
Just look at 'em!, just look at their faces...doing' good art AND good science!*

While this touchstone event actually happened, it was unusual in how clearly the connections were made between using art materials/teaching art skills and learning science/doing science. More typical was the feeling that I was not sure whether I was doing a good job teaching science through art. In addition, I often wished I could do more

for Annette and her students but was not confident that I was in fact helping...this occurred for a variety of reasons and manifested itself in numerous ways. The teacher cases below attempt to problematize the collaboration and ways we tried to teach science through the visual arts.

Introduction to Case One

When teaching any interdisciplinary curricula (defined as teacher-created instruction of two or more disciplines at the same time (Pate, in press), there is often a pull between the subjects – for example, can the teacher allow the instruction to shift with student interests such that a lesson becomes teaching art for art’s sake? Or, should the goals (set prior to the instruction) remain unaltered; for example, should science remain central to the lesson if the initial goal is to use art as a vehicle to teach science?

Since I was co-teaching with Annette during her science classes, I felt pressure to place science at the forefront of my work. I was particularly cognizant of this because I frequently found my work with students slipping towards my passion for doing and teaching visual art. In addition, I found myself constantly questioning whether what I was doing was good science teaching.

This case is about a situation where I felt a strong tension between the teaching of art and science. I perceived that the art activities that were incorporated as part of our science unit were not leading to science learning. In some ways, this case is on the opposite end of the continuum in relation to the introductory touchstone event (in which I felt an almost perfect resolution to that same tension). Instead, case one positions me questioning my efforts as I tried to remind myself to initiate science talk while the students painted their landforms with my watercolor brushes and paint sets. Even so, I

finished many of these lessons believing that I had not engaged students sufficiently in science talk, but rather, had focused all of my energy on guiding them to do beautiful watercolor paintings. Eventually, most students chose to display their watercolor paintings for an art exhibition that becomes the conclusion of this case. I find some resolution as I discuss how science became integrated with art as part of the exhibition.

Case One: Dang it!, I forgot to talk about the science again: When using art to teach science doesn't really seem to teach much science.

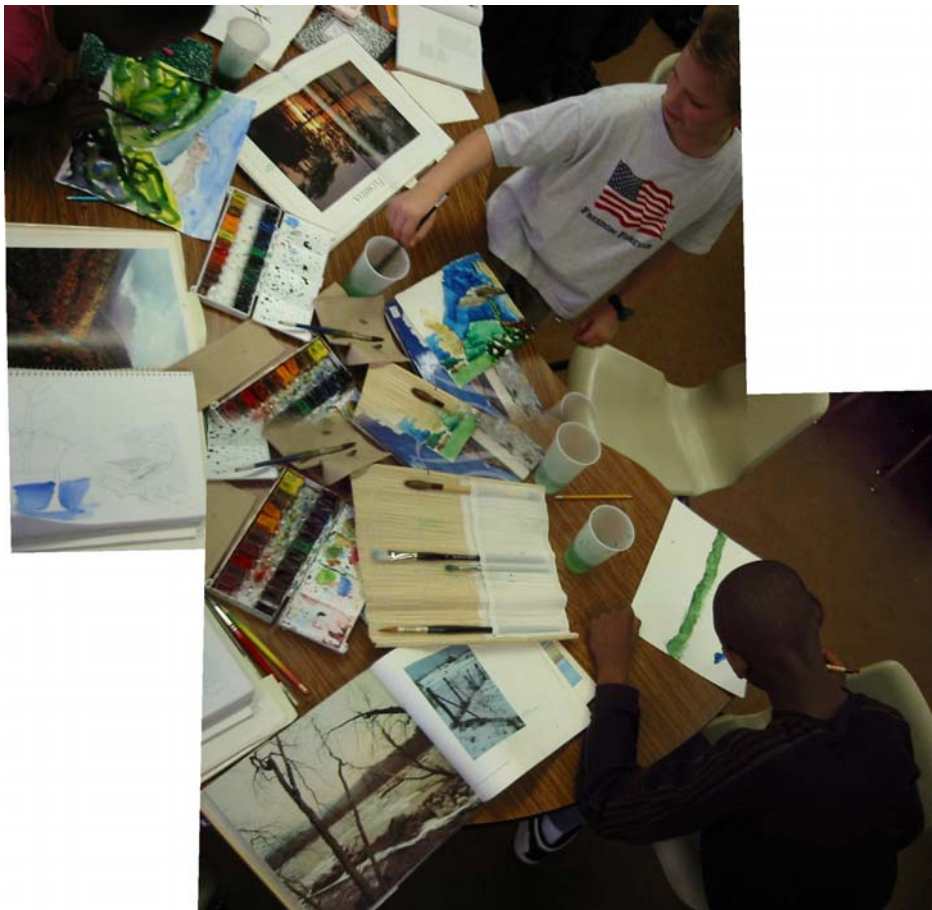


Figure 4.4. Jermane (bottom right), and DJ are at the art and science table using watercolors to paint scenes of landforms, as part of a geology unit.

'This ain't science, not what they're doing anyhow,' I think to myself. It may be good art but it ain't science. Just look at my hand (see Figure 4.5 below). SCIENCE is

written right there in black marker to remind me to integrate science. I wrote that word almost everyday I worked at the ‘art and science’ table these past three weeks to remind myself to engage the students in science, not just art.

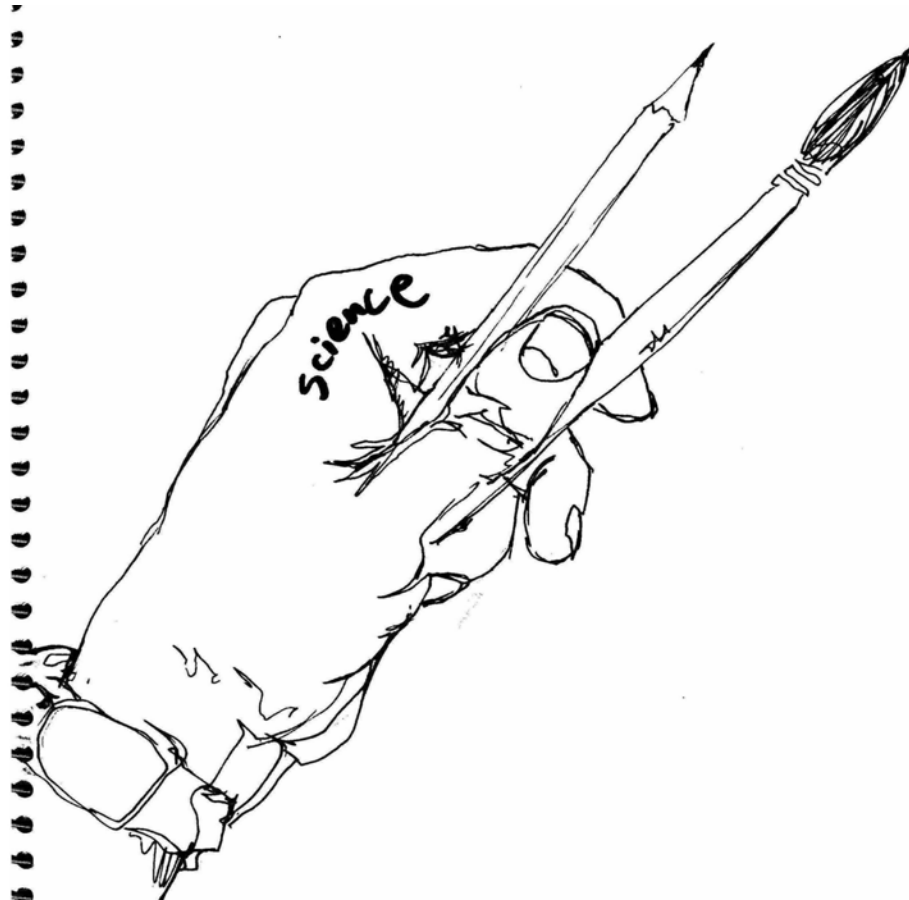


Figure 4.5. My drawing of my left hand with the reminder of ‘SCIENCE’ written where I always saw it.

“Oh!, DJ, use purple here instead of black, it looks better.”

Where was I? Oh yeah, this is not good science. And darn it, if I’m doing a science education dissertation, I need to be teaching good science. Plus, this isn’t their art class, this is their science class. But just look at that beautiful aquamarine color – I love my Yarka watercolors. I’m glad we’re using real watercolor paper now.

Focus!...Jamie! Come on, this ain't science! Sure, it's related to science. Yeah, our unit is on landforms and geology, and they're certainly LOOKING at landforms, at the books in front of them. But they're looking at the ART in those books (even if there's lots of science in the fine print). And just yesterday, my advisor asked me, "Where's the science stuff?" We were looking at some of the pictures of me working with the kids at my 'art and science' table. "Where's the sand and the landform models and the rock samples I lent you last week to use in this unit?" I know where it is...all those supplies (including even more geology stuff from the museum) are tucked away in the boxes just a few feet from my own feet – but I'm not using them. With what I'm doing right now, we'd be more comfortable in the art school than in any science laboratory. But Annette and I decided this would be a good way to integrate the visual arts with the concepts they needed to learn for the QCC earth science objectives. Landscape paintings after all are of landforms. And what better time to talk about landforms and how they are formed and reformed than while painting them; rendering mountains and rivers, valleys and sand dunes. Except I keep forgetting to talk science...it seems like I barely have time to help guide them in drawing and using watercolors. And plus there's a good chance these paintings will be the ones that get shown in our upcoming science and art exhibition – so they need to be good!

Plus Annette is going to do a sand erosion experiment with them tomorrow. In fact, I can hear her talking science right now; she's telling the students (those not at my table) to label the layers of the earth in their science notebooks. Yup, that the plates on the outer layer move into each other to form mountains...mountains like the one Roy is painting.

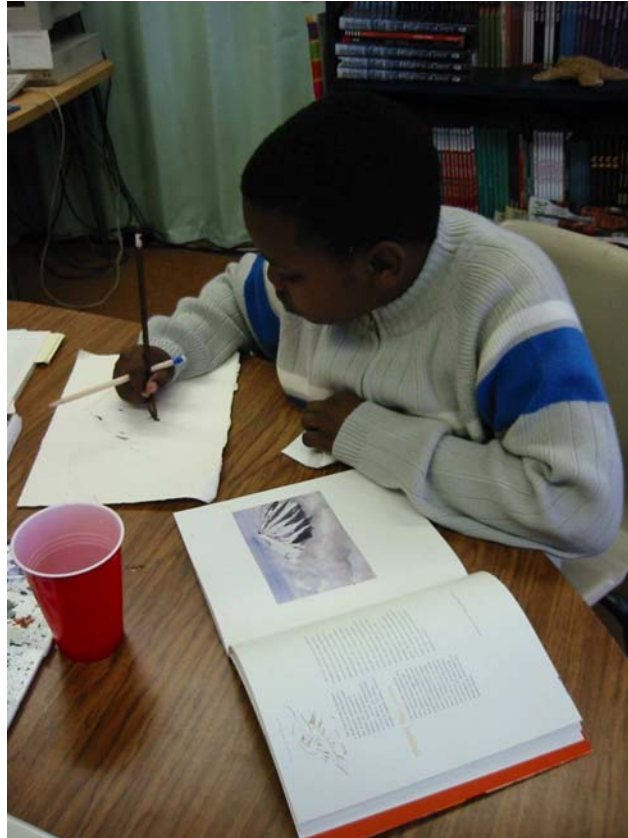


Figure 4.6. Roy paints from an art and science book at the art and science table.

‘Oh, Roy, use more water, you don’t want those streaks you get from dry brushing. Yeah, lots of water, uh, and lots of paint to...that’s right! Nice!’ Annette’s right, he is a joy to work with. A little shorter than his peers, Roy has a lot more maturity than most of his peers. But he’s still a kid, in the best sense of the word - curious, honest, excited about learning, and quick to help people if they need it. And that painting he’s working on is coming along, even though it doesn’t have much to do with Georgia landforms (see figure of Roy’s finished painting below). But Roy choose it, and one of the things I believe is that students need to have ownership in their work and a large part in deciding what they will paint. This is especially important when many have already lost or never developed much confidence in their own ability to create drawings and paintings.

For the last two weeks, I've looked down at my hand after school to see the word 'SCIENCE' and I say, 'Damn it, I forgot to talk about science again today!'

But when I think about their paintings...yes, oh yes, those paintings are gonna look good all framed up and on display in the College of Education. Just yesterday, I got to show off a few that I matted and prepped to be framed (see Figure 4.7 below). But even then, I stood up in front of all the fifth graders sitting around me on that carpet, and you know what I said? "Art this, framed that, reception here, refreshments there." And you know what I didn't say? "Science this, geology that, plate tectonics here, erosion and rock cycle there." Barely a peep! Just a little bit on the fact that they were going to have to write about the science in their art work and it would be hanging up next to their paintings.



Figure 4.7. I'm holding two examples of the students watercolor paintings as we all prepare for the art exhibition. Miguel, Allen look up (pictured at right) as Ty looks up too (pictured at left). I'm holding Miguel's painting; it is the one closest to him.

Questions for reflection.

1. What other pressures keep teachers from teaching things that they are passionate about or that might be best for the students? What are some ways teachers can balance those pressures with instruction and activities that do not "meet the curriculum" directly?
2. Was it okay that Jamie continued to forget to 'talk science?' Explain your answers.
3. What are the limits and possibilities of planning and teaching interdisciplinary curricula? Cite real or imaginary examples in supporting your answers.

Epilogue to Case One. What follows next is an epilogue to the story above in the form of 'what happens next...' in essence, it is my answer to the question, "Was it worth it to use art to teach science when it doesn't seem to teach much science?"

January 16th, 2004, One week later...the art and science exhibition reception.

Okay, it all seems worth it. Yeah, all the time I spent at the art and science table feeling like students were only doing art. But now I think Annette is right! Even if the fifth graders didn't talk about the science concepts and processes while at my table, they had to talk about the science in other ways. Annette and I developed a writing assignment in which each student had to describe the science in their paintings. It was part of their 'artist bio' that hung with their painting (see Figure 4.8 below).



Figure 4.8. This is Hui Jung's painting with his artist bio hanging below it. The other hanging piece is another sample of his artwork, a drawing of a catfish skull.

Even though I only mentioned how science related as a ‘peep’ during my spiel to the students about the exhibition (see Figure 4.7 above), Annette gave very clear instructions and some guidance on writing about the science in their paintings. And at the art exhibition opening reception that occurred a few days later, the students had to talk science to their reception partners (each fifth grader was paired with one of my university students – the reception fell on the second day of my science methods class for early childhood education students).

With all my worries over the tension of not doing good science because of the distraction of doing good art, it helped that Annette wasn’t worried about this issue – she kept saying, ‘It’s okay Jamie, the kids are getting their science with me four days a week, so it’s okay that for one day a week, they do ‘art’ during their science time. I’m okay with that.’ In other words, the students’ time at the ‘art and science’ table was worth it to Annette, even if I wasn’t doing a good job teaching science. Annette was sure they were still getting enough science with her.

But I would then lament that I was suppose to be teaching science using art, that this was part of my work as a science educator. And Annette would give me some practical ideas like, ‘Okay, tomorrow, you can start by sharing the science in all four of those students’ images before y’all start painting.’ And I’d think, ‘Yeah, tomorrow...’ And that tomorrow came again (and again) with me looking down at my hand’s message at the end of the school day saying... ‘Damn it, I forgot about the science again.’ But I realized at the reception that Annette was always there with her students to follow-up with the science. We really did compliment each other well. She rarely forgot to bring them back to the science goals set out by the state curriculum. And at the reception, the

students had to do it all over again with their university partners – to talk science and relate those conversations to their artwork.



Figure 4.9. Jermane and his partner for the reception (one of my university students) discuss his work (1/16/04, photos by J. Randolph).

Some students even had to talk to their parents and teachers (see Figure 4.10 below). Is this the best way to teach science? I don't know. But based on the things I saw and heard during the reception, I'd do it all over again!



Figure 4.10. From left to right, Annette with Roy at the art reception, Roy's final painting, and Roy's mother and Roy with his mother (1/16/04, photos by J. Randolph).

Introduction to Case Two

In this case, I share one of the ways the classroom teacher, Annette, and I explored our teaching roles and responsibilities. We both use metaphors to elicit ideas and questions about how we perceive and prefer our roles to be – while the students are included in the metaphors, the primary focus is on us, the collaborating teachers and curriculum planners.

We were in the midst of teaching our second science unit together, centered on the topic of ocean animals. Our roles had already shifted a lot from our initial unit teaching together, in which I attempted to be the primary instructor, or ‘guest science teacher’ with only minimal help from Annette. Between that first unit and what follows, we negotiated a different set of primary instructional roles. Annette would lead most whole-class science instruction. I would mostly work with small groups of students that rotated in and out of the ‘art and science’ table in the back corner of her classroom. Those not at my table would be taught by Annette.

What follows is our dialog as we explored one way collaborators can negotiate and clarify shifting instructional roles. As you read this case, think about collaborations you’ve been a part of in education. How do those experiences relate to this story?

Case Two: Campfires and dinner parties: Our shifting classroom roles and responsibilities.



Figure 4.11. Annette in foreground working with most of the class; I'm working with the remaining four students at the 'art and science table' (top, center in picture) (12/17/03, photo by J. Randolph).

Even though I was really lovin' it, I did feel a little guilty about the way things had changed. Now I only had to work with a few students at a time. Annette was doing all the management stuff (Thank God!). And she was even leading most of the discussion with the whole group (while I sat and did field drawings of her and the students). Whenever I did talk to the whole group, it was sandwiched by Annette's introduction "and give Mr. Jamie your full attention because he's going to be talking about..." Then

I'd give a spiel in my usual roundabout way. It would be followed by Annette standing back up when I was done and saying something like this: "Okay class, that means you're going to be... [insert clear directions and expectations]...and here's the science you need to be focused on learning,...[insert clear learning goals and objectives related to the state curriculum]...so do that and do it well or else...[insert consistent and fair consequences that would result if student did not meet aforementioned expectations]."

It was great! Not only did I not have to tell Dominic to get back in his chair, or Janet to stop talking so loudly, I also could really know that the students were getting much clearer directions and expectations (compared with the debacle that was my first unit taught with Annette when I gave most of the directions for activities in which the whole class participated. It became very clear that I needed to co-plan and co-teach with Annette to succeed in teaching science using art.

And not only did I perceive that Annette was doing all the hard stuff, the things I did get to do with the fifth graders were like play-time. I mean, it was the fun stuff...like drawing pickled ocean animals and bones or learning how to draw from pictures of whales.

How often does that happen?! I got to do the stuff I wanted to do, and it was the stuff I was good at doing with the students...things like supporting students' creative efforts with positive encouragement and bringing in materials that related to their interest; for example, books on sharks, even on drawing cars and trucks. I didn't have to grade or discipline. I just did what was more natural to me...compliment the students on their drawings while giving them tips and ideas by showing them my drawings (see

Figure 4.12)...sometimes when talking to the students during breaks my drawings had little to do with science but a lot to do with what the students were most interested in.

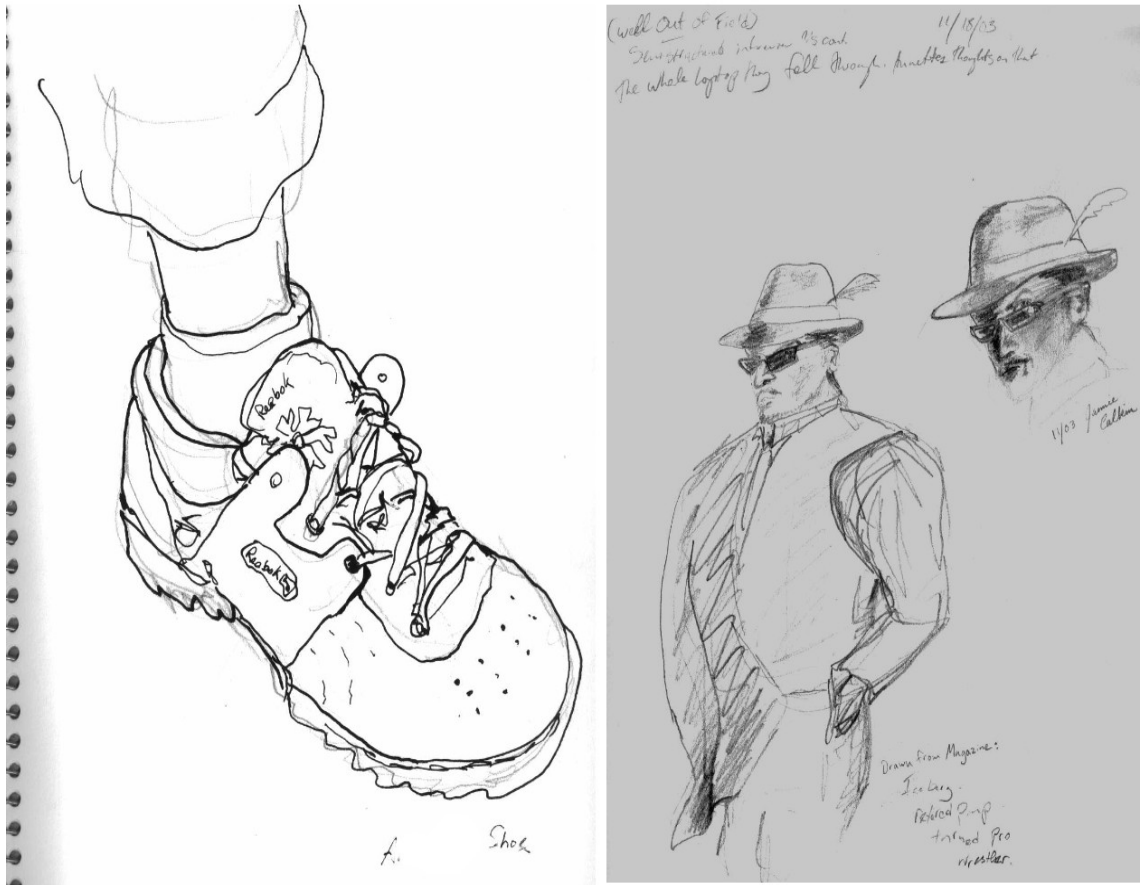


Figure 4.12. I did these drawings in my field journal and shared them with Tarek, Allen, and others in an effort to connect with them. The drawing in the above right is done from a magazine about a video game – the picture is a ‘retired pimp,’ the favorite wrestler of Tarek’s. Above left is Allen’s shoe, something he asked me to draw.

I compare how our roles played out to a scout trip, where Annette and I are the scout leaders (see Figure 4.13 below). There’s all kinds of stuff that has to be done, and it takes the scout leaders’ direction to get all that done. But in my metaphor of the scout trip and at that time during our co-teaching, I felt I wasn’t doing much of that ‘leading.’ If anything, I was distracting the ‘scouts’ from their tasks by engaging them in the ‘fun

stuff.’ Heck, I was starting fires sometimes, distracting the students from their ‘real work!’ In my representative drawing of this metaphor, I’m with some of the ‘bad boys’ starting a fire, even though there’s already one fire roaring nearby. I’m saying, “Isn’t it fun to start fires!!!” I was all about trying really hard to please the students and making sure they had a good time doing the activities at my ‘art and science’ table.

From my perspective, it was painfully obvious that Annette was doing all the hard stuff – in the metaphor drawing, she’s shouting out directions and rebukes, all the while getting firewood for the first fire I had started.

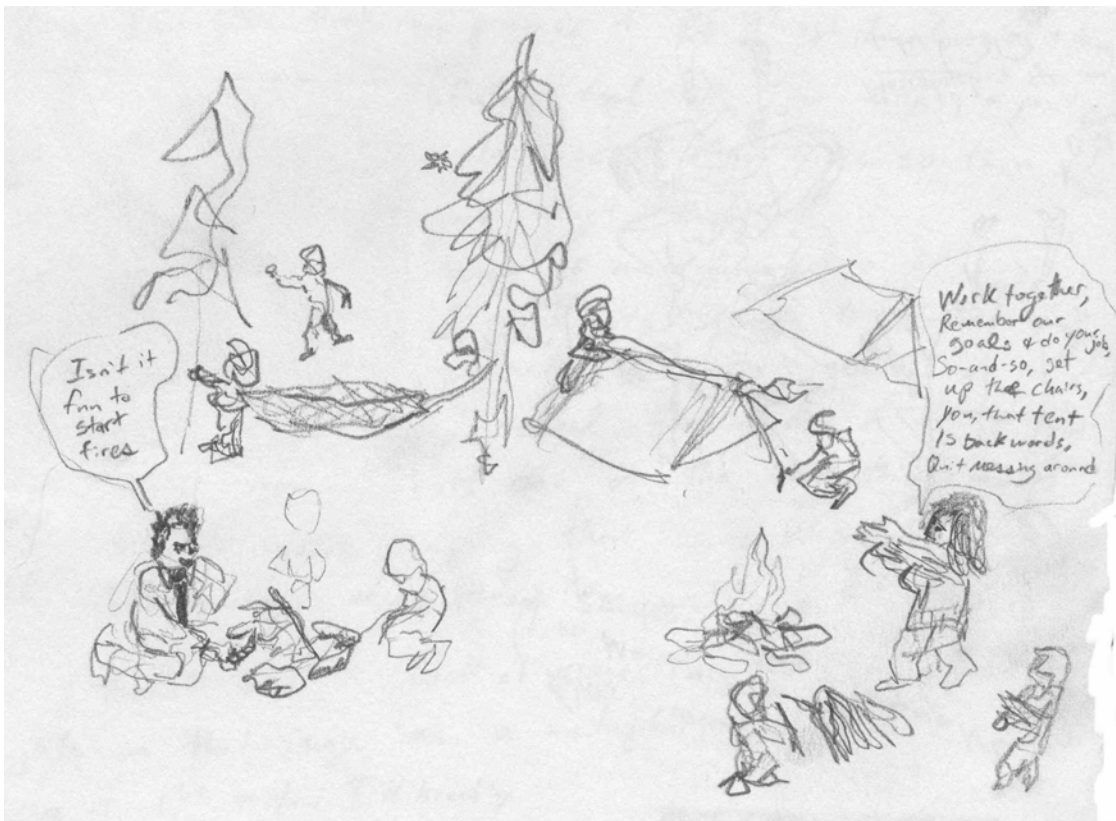


Figure 4.13: My metaphor of our teaching roles as displayed in a ‘scout-trip’ scene. I drew myself in the bottom left corner and Annette in the bottom right. (My entry in Dialog Journal 2: 10/29/03).

When I shared the metaphor depicting our teaching roles to Annette, she loved the idea of metaphors but expressed concern that I was a little hard on myself. She so often told me not to feel guilty about the way things were. “I’ve chosen to be here as their classroom teacher, you don’t have to feel bad that I have all this work to do,” as she pointed to a pile of papers to be graded that evening after a grueling day of teaching. “But it’s not fair that I only have to be here for an hour a day for a few months and I become an expert on elementary science teaching.” I thought about my own experiences as a high school science teacher and how I believed I could do the most good as a classroom teacher. But at the same time, being one took too much out of me – which is one reason why I chose to be in graduate school instead. And in the ivory tower, I often felt like I did little good, that I wasn’t where I should be, where Annette was day in and day out, trying to teach kids. I always felt like Annette worked so much harder than I did. And even though she was also a Ph.D. student, I was on track to finish well before her and earn the official paper recognition as ‘the expert.’ Yet all the while I believed Annette was much more competent as a teacher and a student of students. But she knew all that, I had shared it with her before. And she wouldn’t hear of it.

Instead Annette suggested an alternative metaphor in which my role was much more positive. (See Figure 4.14 below).

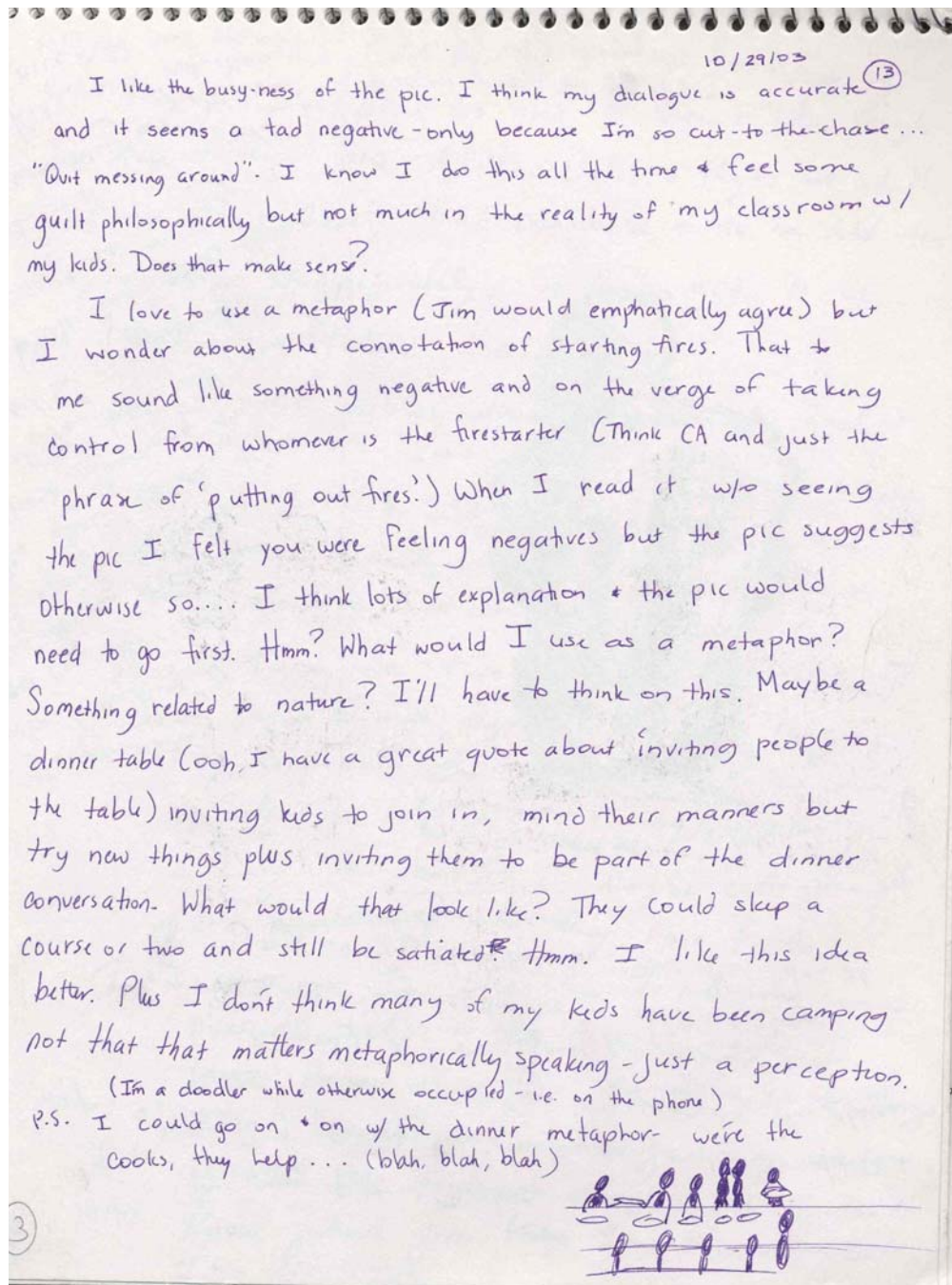


Figure 4.14. Annette's words and drawing of an alternative metaphor to my scout trip.

The students, Annette, and I are sharing a meal at a large table. (Excerpt from Dialog journal, 10/29/03).

Annette mentioned that her metaphor came from a great quote about "inviting people to the table..." She shared how we interacted with the students in the metaphor,

“inviting kids to join in, mind their manners but try new things plus inviting them to be part of the dinner conversation...They could skip a course or two but still be satisfied.”

When I thought about the dinner metaphor, I liked it too. But when I thought about hosting the dinner party with Annette, I didn't feel like I was doing my share of the hosting. I wanted to do as much as I could to help, but so often I didn't know how or even where to find some simple item like the stapler. So in my next dialog journal entry (see Figure 4.15 below), I drew a scene where I was in the kitchen with Annette and I couldn't find a spoon (you have to be pretty lost in a kitchen if you can't find a spoon). She's busy at the sink, with 14 different things taking place.



Figure 4.15. I add to Annette's dinner table metaphor by drawing myself (center) and Annette (right) in my own kitchen, while the students are seated at the dinner table (far left). (My entry in Dialog Journal 2, 11/5/04).

When we discussed this scene (Figure 4.15 above) after school one day, Annette reassured me by saying things like, “Of course we’re not equal partners in the ‘hosting of the dinner party.’” And “Yeah, there are times where you have to ask me where to find something. But that’s okay. You’re still doing your best and bringing all kinds of things to that dinner table.”

“And speaking of the table,” she said, “I think the power of that metaphor is that we’re sitting around the table WITH the kids. In your picture, we’re in the kitchen and they’re at the table. I think we should be at the table with them.”

That sounds good, I thought. “Well...” I said, “Since we’re at the table, what are we going to do tomorrow when the kids are here with us.” That school day ended like so many others during my time with Annette, with a planning session intermingled with lively digressions of silly, wonderful, and/or troubling things the kids had said or done.



Figure 4.16. Annette and I at the end of another long day (1/14/04, photo by J. Randolph).

Questions for reflection

1. What are some different ways collaborating teachers can communicate effectively with each other? What are ways they can negotiate their respective roles in the collaboration? What are important roles that need to be played in collaborations?
2. What are the roles teachers can play in collaborations? What roles are you most comfortable with? Uncomfortable with? Cite examples for each.
3. How can teachers' personalities add strength to a collaboration? In what ways can teachers' personalities subtract from or weaken collaborations? Provide personal stories to support your answers.

Teacher Case Two above is about some of the ways Annette and I negotiated roles in our teaching collaboration. The next case is about how we adjusted when we fell short of our own negotiated roles. Specifically, the next narrative (teacher Case Three) is about not having what I call 'beautiful lesson plans.'

Introduction to Case Three

The purpose of this open case is to explore the tension I felt between not having well organized, defined lesson plans and the need to 'just do the best you can with what you've got.' Both Annette and I are experienced classroom teachers who can draw on toolkits developed over years working with students. However, even the most experienced teachers can lose focus on what is important to teach without proper preparation.

To compound the tension, I knew, intuitively at least, that one of the key factors in successful collaborations is communication and knowing what each collaborator

expects to accomplish. It follows that the best way to communicate these expectations between collaborating teachers is through detailed, well-organized lesson plans. It is an understatement to say that this is a weakness of mine. Luckily, I never worked for a principal that checked weekly lesson plans, or my years in the classroom might have been much less than five. I like to plan at the last minute, and when I do plan, it is not sequential or detailed at all. Instead, I love to brainstorm and have a long list of possibilities only to decide at the last minute on which to enact.

Case Three: I'm sorry I'm not better prepared...why I wanted to have 'beautiful lesson plans' but didn't have 'em.



Figure 4.17. What a slacker I am...I'm sputtering on about plans but having no typed/organized lesson plan for Annette as she listens patiently (1/14/04, photo by J.

Randolph).

Look at me, I haven't even showered! I was late getting here today. And I certainly don't have a good lesson plan to share.

'Annette, I'm struggling with this...I'm just not as prepared as I should be.'

‘Jamie, neither am I, but that’s okay, we’re doing the best we can. Things keep changing and that’s okay. I’m flexible. And it’s okay that you don’t have everything written out.’

This is just another one of those discussions I had with Annette where I wanted to confess my sins, ask for forgiveness, and expect to hear how many ‘hail marys’ I could do to make it right. And it’s just another time where Annette reassured me that we were both doing the best we could and that I was not to feel guilty and that I needed no forgiveness.

At the root of my worries was my expectation – ‘beautiful lesson plans’ were essential to successful, collaborative teaching. Truthfully, the time and energy it would have taken for me to write these documents would have taken a large toll on me. These tasks are not naturally what I do well in teaching, and so it would have taken extra energy and time away from an already stressed schedule. Still, if a full-time graduate student can’t do this as part of his own dissertation research, how in the world can real teachers generate ‘beautiful lesson plans’ for just part of their instruction in their already over-stressed days?!? Perhaps that’s the point – that administrators and evaluators should expect that what is seen when looking at teachers’ collaborations really depends on the nature of those collaborations and the gifts and talents AND weaknesses those teachers bring to their collaborations.

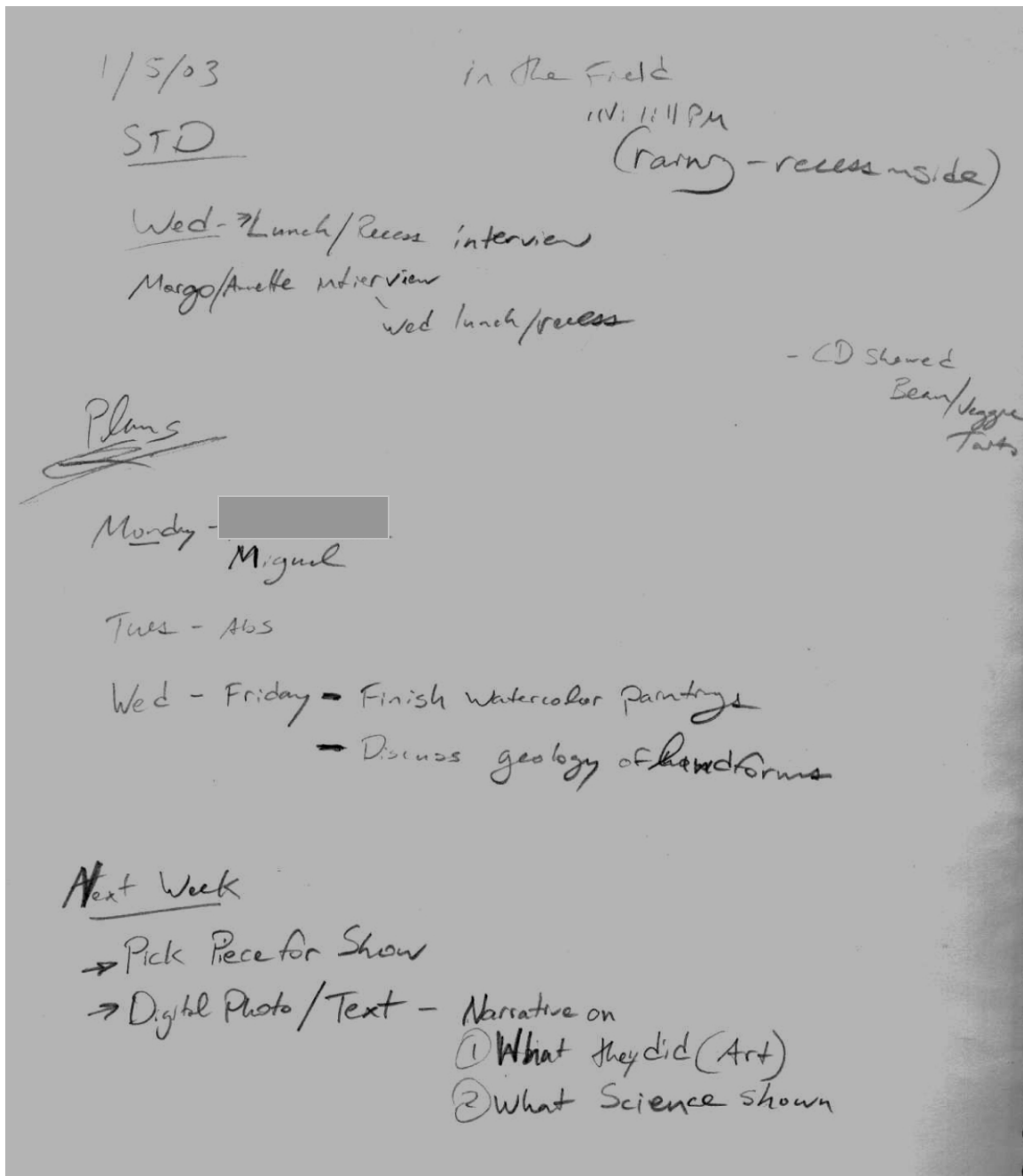


Figure 4.18. A page from my field notebook. This page represents the typical level of detail of many of my lesson plans by the end of the study (from field notebook 4, 1/5/04)

Just look at that (see Figure 4.18), what kind of a lesson plan is that. “Annette always worked with what I had, what I brought. Perhaps I was so hard on myself that she sensed that her role was to support me and not press for the things she was gifted at –

sequential, logical thinking and planning. She certainly was flexible in integrating the talents and gifts I brought into her classroom. By this I mean that my enthusiasm and big ideas were not squelched by the confines of her classroom; quite to the contrary, she and I were able to figure out how to incorporate my creative imaginings (like art exhibitions and scientific illustration in fifth grade – something my scientific illustration instructor at the university said was impossible) into something that was both aligned with the state curriculum goals and feasible within the crunch that was her instructional time.

“That’s one of the great things about our work, Jamie” Annette said one day. “You are bringing in ways of teaching and thinking that are different from my own. That really helps the students...to work with in different ways doing different things.”

I said, “But what about the QCC’s and, what’s that standardized test, with the letters?”

“The CRST. Let me worry about that stuff,” she retorted. “This is good for the kids, and that should be enough.”



Figure 4.19. Annette and I in motion: photo taking during actual teaching time (1/14/04, photo by J. Randolph).

And there were times when the roles were reversed...



Figure 4.20. I'm listening to Annette as she explains how she's not as ready as she'd like to be...the tables turn (1/14/04, photo by J. Randolph)

"I'm sorry I wasn't more prepared for today's science lesson," Annette told me. "I really winged it. Last night, Harper (her infant daughter) was up at least once every hour.

"It went great!" I said. "Please don't feel like you need to apologize to me. I couldn't be happier with my study and our work together. You don't need to have those lesson plans for me."

"I know. I'm not that worried about doing those things for you," she said directly, without guilt or shame. "I just know that I could be doing such a better job teaching science if I was only more prepared."

In the silence of our pause as I looked down at my field notebook, I reflected on how difficult it must be to have an 'educational researcher' person in your classroom,

watching everything. I thought about how I never could have handled having a graduate student in my classroom when I was teaching high school a few years ago. But I could have used a supporter then. I remind myself that one of my roles was to support Annette and that meant helping her know that she was safe with me working in her classroom. ‘Come on Jamie,’ I thought, ‘think of some things to share about what went well, and how impressed I am that she does all the stuff she does.’

“Annette, what you do in here, it’s...it’s just...incredible, amazing. I marvel every time in here about how much you’re able to juggle, how you seem to know what everyone is doing, how much the kids work for you,” I stammer, in part for effect, in part because I am so really amazed at what she does. “Please, remember I’m happy as a clam, really thankful I get to work with you. Things are going great that way, really!”

It’s not the first time I tried to express that and it wouldn’t be the last. If there’s one thing I learned from my work with Annette, it is how difficult it is to be an elementary school teacher, and how the really good teachers make it look so easy but still work so hard at it.

Questions for reflection.

1. What is the best way to teach about lesson planning in teacher and science education programs? How does this fit and/or conflict with how effective experienced classroom teachers’ engage in lesson planning?
2. What should lesson and unit plans look like when teachers collaborate? What is fair and unfair to expect of teachers?
3. How does the emotion *guilt* play into teachers’ collaborations? In productive or positive ways? In unproductive or negative ways?

Case Three above illuminates one of the nagging issues for me in the collaboration – that I should have been more ready for each day working with Annette by having what I envisioned as ‘beautiful lesson plans.’ Still, there was some resolution to that tension in that I shared my concerns with Annette and conversely, she shared the same concern with me on occasion. The next narrative, teacher Case Four, delves into the issue of how we worked to resolve the tension of breadth vs. depth (teaching a greater number of concepts and/or processes in a smaller amount of time vs. teaching a much smaller amount of concepts and/or processes over a greater amount of time) within the context of our collaborative efforts to co-plan and co-teach science units using visual art.

Introduction to Case Four

This case is about a conversation I had with Annette, when we were reflecting on our first unit together in preparing for our second. It marks an important time in my work with her because it is clear in retrospect that this conversation is when she really started sharing her opinions and I really started listening to her. After this, we became much more of a team, a much better collaboration...because the reality was that Annette’s strengths are in planning clear, coherent, sequential instruction. Conversely, my strengths include creativity, innovation, collaboration, and integration. For example, I pushed for and creatively found a way to do a collaborative dissertation study in a real classroom in which I could work with an excellent teacher to help me integrate my passion for the visual arts with my vocation of science education.

This conversation marked both a confrontation of our two approaches to planning and implementing instruction and a negotiation of our goals and approaches. It took place

in July of 2003. We discuss what worked and what didn't in the June unit with the goal of improving it for the new school year.

In this case, Annette really starts working with me...after I invited her to do so. It is in this case that we really start collaborating, that is, co-planning for co-teaching. You should learn from this story some of the things that led up to this successful turning point and some of the things that we were able to overcome.

Case Four – If more is less, then less is more – a narrative of co-reflecting and co-planning (How Annette mentored me in teaching and how not to just ‘throw the kitchen sink at ‘em).



Figure 4.21. I did this sketch in an effort to relay how I felt at the end of our first unit in June. Although the drawing was done in September in preparation for Mural Two, the feeling of frustration was still fresh in my memory when I drew it (from Art Journal, 9/17/03).

Boy, oh boy... teaching that first unit on oceanography was a royal pain (see my drawing depicting how I was feeling at the climax of that first unit). It's now July and I'm thinking back on my planning and teaching last month. It was a disaster! And what's

worse, this has happened to me before... this situation where I wanted to do so much in my teaching...I expected so much of the students...I thought all my grandiose ideas, projects, murals, and all kinds of innovations were possible to do; that the fifth graders could and would do all that stuff...at the end of their extended school year. And what happened? The same thing that always seems to happen in my teaching...I carried piles of things in, and tried to teach too much, do too much, without enough direction, clarity, or expectations. Almost everyday I went into the school, I got a big Rubbermaid tub out of my car and on the way to sign in at the front office, left the tub by the outside door of the classroom. The tubs were filled with things including art materials like watercolor paper, brushes and paints; science stuff like marine fish specimens in jars of alcohol and bone specimens; and even cans of sardines, anchovies, and caviar (I almost couldn't fit all the tubs my car when I packed up my stuff at the end of that unit).

Yup, it was the end of the school year for those fifth graders. It had been a long year for them – it was June and all the other kids from the other schools in the district were on summer break already. Their teacher, Annette, had her first child in March after a difficult pregnancy that required numerous absences during her first year at the school (not her first year teaching). She had done a magnificent job reestablishing routines and expectations after each extended absence. Fearless and very much in control of herself with the kids, quietly assertive around other adults, Annette said once, “Oh, I’m happy in my classroom just being left alone. I’m happy being an island.” (It was always fascinating to me that Annette maintained this ‘my classroom as my island’ attitude while at the same time, always making me feel welcomed, an outsider from well outside her island.) But everybody, even Annette, had long ago been ready for summer vacation by

the time I started teaching that unit. And I had so much stuff to teach, so many things to do...

But what came out of the unit? What do I have to show for all the time and energy and money I spent teaching science through art? I've got piles and piles of trash and mounds of scattered stuff that barely resembled the curricular materials I went in with. Plus a dead lobster (I had brought in a live lobster from the grocery store to show the students – freezing it alive was the most humane thing I could think to do with it because I had no intention of eating that lobster and the grocery store wouldn't take it back), a lot of broken promises I had made to the kids (like that we'd paint a mural and that they'd get to keep one of their paintings – they never even finished their first painting but I wanted to keep that first one...for data), and a fear in my gut about things to come. And I have no clue what the students took away from my teaching or if they even learned any science.

Okay, the description above may be a bit of an exaggerated summary of what happened in my first two-week teaching experience in Annette's classroom. But there were many times in my mind when it seemed that bleak...when I felt paralyzed because I couldn't see anything but failure and self. It was that voice inside my head again; the one that had driven me crazy when I myself was a classroom teacher...never satisfied, never good enough, always the bad stuff was remembered. And now, going into the planning session with Annette following that June unit, I was ready to listen. Before, in early May, I really wasn't ready to listen – I believed I knew enough to do most of the teaching and planning without Annette's help and feedback. I'd been at the university for more than three years...I knew everything. I believed I could teach the chemistry, physics and

biology of marine habitats as well as watercolor, acrylic painting, drawing, and other art skills, all in two weeks for one hour a day. Now, looking at the piles of trash mixed with art supplies, curriculum materials, and science stuff, I am now ready to listen on this July afternoon meeting with Annette. Today, we are going to discuss what happened in the first unit and how we are going to collaborate on the next two units together. And I have cut off a big piece of humble pie by reflecting on this first unit in preparation for my meeting with Annette. I had looked back at my lesson plans, at our dialog journal, at my journal entries and photos...I looked at the art projects half finished, and everything pointed to teaching and learning so far below my initial expectations of what it would all look like. It was really humbling (especially since I was blinded by the failure so that I couldn't see any of the successes).

I am still chewing on that humble pie as the meeting begins. After a few minutes quietly reading my handout (with the quietness eating at me, 'let's get to chatter, forget the reading,' I'm thinking...but she always started our conversational interviews like that), Annette asks where we should begin. I ask her what she thinks the students will remember from my unit. First she mentioned how the kids will remember how salt water evaporated leaving salt crystals (an experiment left without discussion because I ran out of time).

Then she said, "And the students did talk a lot about the art supplies and enjoyed using them. The paint and the pastels. Those are the specific things that they will remember from it. The concepts, I think they'll remember the word adaptation and have a basic idea of what it is."

At this point, I am sarcastically thinking to myself, ‘Okay, this is good; they will remember adaptations, ONE of the seven or eight state objectives; but for all my work, that’s all. That’s all they will remember!’ So I move to more specific questions using the state science objectives we used for the unit.

Jamie: For example, the first state objective, ‘Recognizes that ocean water varies in concentrations of dissolved materials, physical properties, and the living things it supports.’ Do you think the students...met that standard or learned those things?

Annette: Ummm, I don’t think so. The one thing that I noticed and wrote about and the last time I wrote in our dialog journal is that I think we need to do less.

Depending on how long you’re there, less is more. Less concepts, more time on the concepts.

Jamie: Umm. (‘yes!,’ I think to myself – this makes sense! Why hadn’t I realized this before? Had she been hinting at it? Well, I couldn’t agree more now.’ My vigorously nodding head...up and down...shows that).

Annette: And more time on the art. Like even less art...art opportunities, but more time on...

Jamie: Yeah. (Again, vigorously nodding head).

Annette: ...Here’s how you’re gonna do it (she’s referring to the students in saying ‘you’re,’ not me). Today I’m gonna show you a technique. Tomorrow you’re gonna try the technique. The next day you’re gonna apply it to this thing that also fits into adaptations, which is the concept we’re talking about. And just kinda stretch everything out instead of just trying to do a whole bunch of concepts.

The conversation we were having was nothing new to Annette. She had guided her husband, an elementary ESOL (English to Speakers of Other Languages) teacher, to numerous teaching successes and changes in his first two years of teaching. And as she said, he was like me, he loved to start things, and do creative projects with his students in an effort to teach too many concepts, go off doing this or that...without careful thought as to why he was doing that. For example, he had his class create comic books and spent weeks on it, great fun, but the learning objectives got lost somewhere in the first week.

And these conversations also occurred multiple times over the course of the study, as we planned the three units together, each with many activities and lessons. Here's how those conversations would go...

I excitedly start, "I was thinking that the kids could ...paint a mural; write, edit, and publish a book; maybe even start a community garden..." Hoping Annette would finish my sentence or give a clarifying question, I instead pause uncomfortably as she quietly reads the sheet I had just given her...a unit plan that I did not finish and that I'm not proud of.

Annette would pause for a while longer, still looking at my 'unit plan,' that is, a flimsy one page paper with the title of the unit at the top followed by a bulleted list of activities that may or may not have much to do with the state objectives. She'd turn the page over to find it was blank, look at the front page again, and say, "What do you want the kids to learn or be able to do from all of that?"

Even though her tone and demeanor is somehow not threatening or accusatory, I remember immediately that I wished I had more done in terms of lesson plans, timelines, etc. And I stumble around an answer like, "I thought that the activities would be good,

that the students would learn a lot about the subject and have fun doing those activities. What do you think?" I ask, having gained some measure of confidence back in answering her question.

"Well, what exactly will they learn? What would you tell the principal if he asked you what the kids should be learning for this unit?" Somehow, she asks this without blame. Still, I can't help but feel like I did when I was a student teacher, so hopeful and so clueless.

"I don't know, I just thought it would be a great way to teach the unit," I reply, with much less self-satisfaction. I'm starting to see her point. "The students should be learning the QCC's, but I haven't looked at them closely. Something about the ocean animals. What were they again? Where's my list?" And I would rummage through the papers in my backpack, but without luck.

And then Annette would start on her role – that is to say, she would speak quickly and not pause in between sentences...actually, she would talk in one huge sentence. And I've seen it now a bunch of times. It's a beautiful thing to behold, like a dam breaking and ideas flooding out like water down a valley. It starts the same way, "Here's what I would want to focus on, this state objective right here (and she'd say one objective, and it was always the one I thought was most important of the three to five that related to the unit).

Then without pausing for long, she would say, "So I would introduce the terms important to that concept, and then we could start an activity where they have to apply the concept to an example by..." And she would sequentially go through the unit all the while integrating my ideas for activities but only if those ideas fit directly to the goals I

had for the students. She would often end her sentences a little out of breath but not after clearly stating the logical progression of the unit as it fit within the designated timeframe.

Annette always made it so clear for me...in those 'here's-what-we're-gonna-do' sentences. And it was never wishy washy. Nope, it was clear and assertively stated...and I always found myself relieved and thinking, "Yeah, that's good! We'll do it that way."

And her 'roles' were not commands; instead, they were hypothetical statements. But they were said with such assurance and made so much sense that I couldn't help but want to write them down word-for-word, maybe even claim them for my own. For example, in the following interchange, Annette and I discuss how to teach the marine animals unit for the second time, in October, 2003 (the first time was Unit One (above) in June with her students from the 2002-2003 school year). As we discuss combining some of the things we did in June, this time, she is telling me how she would do it...how we could do it.

Annette: And so I was thinking that's something else we could keep (referring to eating canned tuna on crackers at the end of the science lesson...something the students loved from the first unit). But turn it into, okay, we're gonna study a tuna, and we're gonna study the whole body parts of a tuna, inside and outside.

Jamie: Ahhuh (head nodding)

Annette: And that way learn about adaptations and then go from there and then maybe doing your clam thing, looking at different kinds of animals, (exhales then inhales deeply...she's rollin' now), and from there, go to either the creative one where they create all the adaptations, or maybe even spend more time on it. Where does this clam live, what does the clam have to do to survive? What about a tuna?

What about these other fish? And I would have them do research. As opposed to them just picking the animal at the end (which was done in the pilot unit). They need to spend a whole long time picking the animal and then learning about that animal.

Jamie: Umhum (as always, head nodding up and down as if to say, 'Keep going, keep going!').

Annette: And the culminating thing could have been creating their own animal. And saying, 'Here's what my animal will be, here's its adaptations, here's where it will live, and why all these things are happening (said with confidence, quickly, increased volume). But they will already have, 'I've studied the tuna, I've studied the clam, I studied the animal I researched, I painted that animal, and now, I'm ready to create my own because I understand.'

After a pause where she caught her breath, I might add how this or that activity would fit too. Or I would comment on how that idea would meet additional personal goals I had. And often the conversation would go back and forth in the process of negotiating how to combine the best teaching activities with the constraints of the timeframe and other things (like students' abilities/interests, materials, etc.). And more times than not, it was Annette that reminded me of these constraints before I got carried away on some new high-flying idea.

Questions for reflection.

1. What is the place of different work/teaching styles in the classroom? In what ways do differing styles present problems for collaborative classroom teaching

and learning? In what ways is it beneficial that different teachers possess very different work/teaching styles?

2. In what ways did Jamie and Annette find ways to negotiate differences caused by their different personalities and teaching styles? In what ways do you think tensions may have been left unresolved?

3. How does your own teaching/work style compare with what you perceive and Annette's and Jamie's teaching/work style?

4. In what ways could you envision yourself collaborating with Annette? With Jamie?

In Case Four above, I describe in dialogue form some of the ways in which Annette and I learned to co-plan together. I learned by trial and a lot of perceived error that I needed Annette's help...that her strengths could help compensate for my weaknesses. In the final narrative, the culminating touchstone event, I delve into an area difficult for me to write about in my study of the collaboration – my strengths and talents in co-planning and co-teaching and learning how to teach science using visual art.

Introduction to Summative Touchstone Event – Jamie's strengths shine through: The story of the art and science exhibition reception.

I write about the story of the exhibition reception to illustrate how some of my strengths as an educator did shine through in the project. I need to write this because it has become clear to me, through the help of my writing group and feedback during the writing workshop, that I am being overly hard on myself. Furthermore, in my effort to not criticize Annette, I am casting our work together in a one-sided way – that she is a pushy

know-it-all who is solely responsible for any of my successes, while I am a bumbling incompetent, clueless, and overly idealistic.

I write it to try to counter what all the narratives I have written so far had in common, that I was being overly self-deprecating and portraying myself in a way that was one-sided (the bad side). The event that is central to this narrative was by all accounts, a “smashing success” (Annette’s words in dialog journal 1/21/04). And it was one where I really did ‘shine’ – where many of my gifts and talents were at the forefront. The event I’m referring to was the reception for the dual art and science exhibition (#1, the fifth graders’ science paintings and, #2, my own ‘research art’ done during the study). It occurred in the College of Education building on campus, on Friday, January 16th, 2003 in the midmorning.

My strengths in teaching and working with teachers and students that I attempt to portray in the story include: collaborating – meeting with people and getting them invested in the project, setting goals which bring in others’ strengths (and telling people what I think their strengths are), bringing people together/facilitating, big picture stuff, creativity, innovation, brainstorming and possibilities, empathy, positive feedback, excitement/energy, sharing – my stuff and others’ stuff, promoting others and self, talking with and relating to young people (and older people) in engaging ways about things that are important to them, and being ‘in the moment.’

I would honestly say that if any one event in my lifetime encapsulated my strengths (as listed above) put to good use, it is the event that follows...

Summative Touchstone Event – Jamie’s strengths shine through: The story of the art and science exhibition reception.

It’s chaos in room 220... “But this is the good kind of chaos” I’m thinking to myself, the kind any school teacher would recognize as a place where things were getting done. It’s only the second class for me and my students, all senior Elementary Education majors. I had a list on the white board a mile long – things to do to prepare for the Art and Science Exhibition. As the class (which was Science Methods for Early Childhood Education) starts at 8 am this Friday morning, some of the students are already a little uneasy with my work style – sometimes scattered, but always done with enthusiastic energy.

*These university students are in a very well structured program, and they’re used to clear expectations and ‘right answers.’ But they are also seniors with a lot of experience with children and a real itch for more experiences **with** kids and less talk **about** kids. Cause they are GAME...game for working with kids on real stuff. And I’ve got a game for ‘em, so I give it to ‘em...pairing each of them up with a fifth grader and telling them to welcome that student, engage that student in a brief activity to get them comfortable with our university and College of Education, and facilitate a lot of conversation with that student surrounding their art work and science learning – and so far, they are game for that. At least I hoped – I put my trust in them, even though I barely knew them.*

Each of the 26 students (part of an extremely homogeneous group in terms of age, gender, and ethnicity/language: 25 women and one man, all White and between the age of 20-23 years old) is paired with one of Annette Santana’s fifth grade students (10 girls

and 13 boys, 16 African American, four White, two Latino, and one Asian). At the first class meeting on Wednesday, just two days earlier, I told them they would each be paired up with a fifth grader. I asked for volunteers to work with students I believed might require extra from their partners, for example being especially shy or students that might potentially 'get out of line' given the opportunity. I was impressed that the volunteers come forward quickly! There was a lot of shuffling around to do though between the u-students and their fifth grade partners, including one who lost her partner because he was caught with a knife at school the previous day and had been suspended.

In this hour before the school bus arrives, we have a lot to do. Each university student needs to secure a handwritten artist bio with a photograph of his/her partners' framed painting. That means pasting the picture of the fifth grader to the bio, then pasting it to foam core backing. I taught a volunteer (a student who came early to class that morning) how to cut foam core with my mat cutter, a large tool used by custom framers. She's on the side of the room, busy slicing away. In addition, volunteers are mobilized to cut string and get glue distributed. Other volunteers are making signs for the exhibition, prepping other pieces (of my artwork) to go in an accompanying exhibition in the next hallway, making nametags, getting materials ready for their intro activities, standing guard at the two entrances to welcome the students and bring them to our second floor classroom...it is a whirl of activity with me encouraging, directing, asking for help, and constantly thanking people. Inwardly, I am very worried that we aren't going to be ready and that I was forgetting to do some crucial element; for I know that professors, deans, parents, graduate students and others hopefully (another source of worry) will be coming in less than one hour.

Bob Hart, a former administrator in the College of Education, is busy in the hallway putting up framed signs and artwork yet to be hung. In his recent retirement, he had volunteered to continue to hang artwork in the building, some his own, others from his vast personal art collection. I knew him from past conversations about art; he had even commissioned me to do several paintings for him. And I knew as soon as Annette and I decided back in October to have the exhibition at the College of Education that Bob was the person who could help make it happen right. I emailed him then and he was on board immediately. We agreed to meet a few weeks before the event and we both were ready at that meeting with lists of ideas, questions, and things-to-do. At that December meeting, Bob graciously agreed to pay me 300 dollars so that I could buy the materials to professionally frame each of the student's artwork. In return, I promised him I would paint pieces for him amounting to that sum (it was another time when my talents as an artist very much came in handy).

Bob is one of those people who is both highly respected and very well liked. He has done so much to make this happen...making sure the exhibition would be successful in so many ways; like contacting the people in charge of public relations in the college so that proper publicity could be done and making sure the newly refurnished Office of Instructional Technology (OIT) would be set up for refreshments. Bob retired from that department as their administrator just a few months before. He also brought extra refreshments. Furthermore, he helped me hang the show last night – it took over three hours but looks great! Lastly, he just told me he was definitely staying for the entire reception to help make sure everything goes smoothly and help everyone feel welcomed. This is a great person to be the liaison between the College of Education and me and my

students. And every time I thank Bob for his efforts, he retorts by thanking me and noting how important my work is.

Katie, my wife, is here at 8:15. I muster a few of the university students to help her get the bags upon bags of food out of our minivan. She baked chocolate chip cookies and brownies from scratch early this morning. Immediately upon bringing them in, the OIT smells great from the still-warm treats. As the culminating event of my teaching collaboration with Annette, the reception needs to be well done according to Katie. And she had done all the shopping, and a lot of baking, to insure that what she could do for it was well done. And it's wonderful to see her in my place of work, scooping sherbet ice cream into a large punch bowl filled with ginger ale. I am starting to feel more confident that things would turn out okay.

'Oh yes,' I tell myself, 'Things are really starting to come together!' And I realize to myself, 'Yes, yes, yes, there would be some great photo opportunities, so great data!' For this reason, I'm glad Annette's husband Jim was coming. I had become good friends with him in the last few months, and a big fan of his artistic use of the digital camera. We had even done an art show together at a local coffee shop in September. And it was like me to find ways to bring talented people together, because I jumped at Annette's idea that Jim could photograph our work in her classroom – and he had done two awesome photoshoots already, getting images we never could have obtained otherwise. And I had helped train him on how to professionally frame artwork in getting his photographs ready for that September show. So with the support of a mini-grant for teaching and research materials, I paid Jim to help me frame the students work. Least expected of all was that Jim added his own informative slant in discussions over my research, as he had

transcribed two of my conversational interviews with Annette and knew about my research project very well.

And there he is! Jim arrives with his camera and his baby daughter, Harper, both slung around his neck. We were up together pretty late last night and we were both pretty cranky about not finishing everything (but it looks like my university students will get it done, and that's all the better, getting them more invested in their partners and the project), but I'm sure glad to see him now. I know his artistic eye with the camera will capture great data as part of my study. As I welcome him to the event, I remind him that I knew he would be taking some great pictures (as an artist myself, I knew it is important to assure him of my confidence in his work). Just like when he took pictures in his wife's classroom for me, I know he'll be able to get good shots because the kids are very comfortable with him and his picture taking.

Unroll the red carpet!: The fifth graders arrive....

My university students continue to scurry around, coming to me with questions, others with solutions to my problems. The bios are all up, hanging from strings below each fifth grader's painting. All of my pieces are up too, freshly hung by Bob Hart and two volunteers. It is coming together...

"Where's the fifth graders?" one of my university students asks.

"I don't know," I said looking down at my watch, realizing everything hasn't come together yet! "It's 9:15, hopefully...oh, alright!" I say as I see Annette and a long line of the fifth graders marching towards us in the hallway. "Here they are! Could you go make sure everyone's back?," I call out to the university students, remembering that there are volunteers watching for the school bus at both ends of the building.

I lift my arms high in welcome. “It is so great to see you all! Welcome to the College of Education! Come on in!” I motioned the nervous fifth graders to go into room 220. I had asked my university students to stand around the room and allow the fifth graders to sit in their chairs.

“Welcome to Aderhold!” I repeat as all eyes turn to me and the last of the fifth graders sat down. “We are so excited that you all are able to be here.” I am loving this. I have everyone’s attention. Even though I haven’t prepared a speech, I’m not worried because I’m so excited that everything has gone as planned so far. Plus, I love the spotlight – and I’m pretty good at making impromptu speeches, after years in the classroom and some natural showmanship. I’ve always had a gift for holding the spotlight and making other people feel comfortable and engaged; this is done with my good eye contact and movement around the room, and an informal, but very positive tone (not to mention some booming volume).

I continue, “We are so pleased to have y’all here this morning. It is wonderful to have real students here in the College of Education,” I say with a wink to some of my university students. “I want to say that y’alls artwork looks great! This is going to be a great art reception! But before you show your partner your art and talk about the science of it, you are going to break up into groups. Your partners will either stay here to start, or go out into the hallway. Each group has some special activities for you to take part in.”

Speaking to the fifth graders, I say loudly with a smile, “When I call your names, my UGA students, go get your partners, and get to the fun!” Name after name is said, and as I hoped, the university students jump right in...some forming groups in the room,

some groups already moving outside the room. I know a little about each group's plans, but as I told them on Wednesday, 'Y'all have already had a lot of experiences with kids, I'm sure y'all will have something fun for them to do and learn.' I had encouraged them to do a little with science and introduce their young partners to the College of Education and the university, but gave them a lot of leeway on how to do it or what science to teach. In other words, I trusted them while expecting a lot of them. The ones that were uncomfortable with the lack of clear expectations could rely on their group members. I think that was one of my strengths...to put the students in situations where they have to work together to meet open-ended demands, in this case, what to do with 2-4 fifth graders for a half an hour before the reception got started.

And now it is my time to just walk around and enjoy! I have set in motion what looks to be an incredible event. All I have to do now is enjoy it and help others do the same – another gift of mine. Plus be available to answer questions and fetch things like tape or a permanent pen. But really it's about doing one of the things I do best – engage people in conversation about something I love (in this case, teaching and integrating art and science) in a setting where kids get to show off their efforts and talents, all with lots of people I've helped bring together to share their own talents to help the cause.

After listening in on one group's instructions for a building-wide scavenger hunt and another's tour of the computer labs with internet 'assignments,' I wander over to the OIT, on the way smiling for the camera twice (it is perfect, there already seemed to be cameras everywhere). Katie's busy putting out the last of many platters of delicious goodies. I'm too excited to eat much, but do indulge in a still-warm chocolate chip cookie before she slapped my hand, saying with a smirk, "Who invited you? And don't mess up

the arrangement!” Bob comes to the table with bags and boxes of other snacks. As I thank him, he says humbly, “Just got them from the store. Nancy and I wanted to support this event, and this stuff is just a backup in case all the wonderful stuff I see here gets eaten up.”

I marvel, ‘how often do I have such backup?’ But the marvels, all of which I proudly know I set in motion, continue. The photographer I talked to yesterday enters the room and introduces herself. She’s from the university press office and has a fancy big camera ready to capture the morning’s events.

“Just let me know if there’s anything I can do for you or anything you need,” I say with excitement. “We’re very excited you could come, and believe me, there’ll be some great photo opps!”

She’s off taking pictures already, noting that a writer will contact me in the coming days to interview me for a story to be on the homepage of the university website. I hope inwardly it makes it to press, knowing that stories often get cut and never used. But already, the College of Education featured a piece on our project written by the public affairs person. It was a great story of what this morning is about, but has added some pressure on me – it came out a week ago and a lot of people, professors, graduate students, and others had seen it and congratulated me. I encouraged them all to come to the reception (not sure I could pull it off but hoping it would look just like this); I said ‘the walls would soon be filled with art and science.’ I’m hoping lots of people come, it is so important to celebrate the students’ work and talents! And to do it with them, here at the university, it just makes me smile at the prospect.

I walk out into the hallway. It is empty of people but the art and science is indeed everywhere. The custom framed paintings are lined up, colors jumping out of the black frames and archival white mats cut to fit each painting perfectly.

Glancing at my watch, it's now 9:30. The students will be at their activities for another few minutes and then I'll start encouraging them to talk about their art pieces and the science behind the work. Yup, there's a group in the computer lab. Good, good, good! Dominic and Roy are really into it! I flash a thumbs-up to the two university partners with them. It's great, every fifth grader has at least one partner, in that group it's a three to two ratio.

Oh, I need to go get the sign from room 220. It describes the exhibition. Returning to the classroom, I find a group of university and fifth grade students. DJ and Hui Jung hold up bags of goodies – 'we found these in our scavenger hunt. It was easy!'

Wow, y'all must be really smart!,' I say to them. "When you're finished with that card game, how about sharing your art with your partner? We'll have 15 minutes before the reception officially begins, and you'll want to all be ready to share with guests." I move past the smiling group to get my easel and the sign (quickly but quite nicely made by two university volunteers) (see Figure 4.22 below).

Once out of the room and around the corner of the hallway, I'm back at the exhibitions. Nice that everything is right here – all so convenient. And it's the highest traffic area in Aderhold – so a lot of people are going to see the work. Awesome! I put the easel up between two of my large paintings, the rest of my work in the adjoining hallway. I'm glad the students' exhibition is here – Bob and I talked about how we both thought their art should be seen more. It is all right outside the OIT and computer labs.



Figure 4.22. The sign was done by one of my university students just before the exhibition. Below it are two self-portraits I did in December, 2003.

Okay, here's another group getting off the elevator, and three more pairs coming from outside. Better remind 'em. "Can I have y'all's attention? Ms. Santana's class, make sure you share your pieces with your partners. The reception will officially begin in about 20 minutes, so make sure you talk about your work, then you can get some snacks before 10 am."

The pairs go straight to their respective art pieces and start at it. The fifth graders are clearly into it and already seem comfortable with their partners. I listen in but don't want to take over so I resist interjecting things I think of, like how well Roy did with a Chinese paintbrush or Lindsay's great perspective. Plus, I notice that they are talking science – and Annette's directions from the days before ring in my ears – "Remember that you are going to have to talk about the science in your pictures." And I recall (with

pride) that I had echoed those instructions to the fifth graders as well as reminded their university partners a number of times to ask about the science.

“These are mountains that are formed by plates coming together,” Lindsay says to her partner. A large smile spreads across my face. Lindsay catches my eye and I just give a thumbs-up sign and walk on, continuing to smile and not wanting to interrupt her.

The rest of the groups return and I loudly share the expectations again, reminding them that when they’re done, they can go have snacks before the ‘official guests’ appear. Inwardly, I kick myself for saying official guests – I want the fifth graders to remember that this event is most of all for them. “You all are most official, but in some ways, you all are hosts, sharing your art and your partners are sharing Aderhold and our campus. So everyone, make sure to share after you get some chow!”

The hallway is filled with commotion. I bump into Annette and her assistant principal. “I’m so glad you could come!” I said, annoyed with myself that I didn’t remember this woman’s name.

She smiles and says, “Oh, this is great. It’s really great to see our students so excited about their learning and their work.” The assistant principal moves on to listen in on the students discussions.

I continue to nose around the busy hallway, trying to not interrupt any discussions. Jim comes to me all flustered. “I can’t do this, Jamie, this is horrible.”

“What are you talking about?” I ask in surprise.

“Every time I try to take a picture, they all get into a pose and smile at my camera like idiots,” he stammers. “I hate taking posed pictures, I can’t do this, and I can’t get any good shots for you!” As if on command, there’s a flash next to us and we both look

at what is the subject of the picture...a fifth grader and his university partner are smiling next to his painting. “See what I mean.” Jim says.

“Look Jim, just do what you do and I know there’s gonna be some great images,” I say. Even though I didn’t expect this problem, I see what he means. His pictures are so great because he captures people doing things as if the camera isn’t there (see Figure 4.23 below)



Figure 4.23. I love these pictures Jim took. They capture so well the feeling of ‘event-ness’ and that the excitement was all about the fifth graders and their work (1/16/04, photos by J. Randolph).

I’m glad such a fuss was being made over the fifth graders (see figure above). With confidence, I repeat my request to Jim, “Just do the best you can – don’t worry about it cause I’m sure I’ll love your work.”

Without me having to encourage them, the pairs start moving into the OIT where all the food was located. As I follow the last of the groups into the noisy room, I’m again struck by what was happening here...real school kids are being catered to and doted on by us at the ivory tower, here in the ivory tower. The spread of food is incredible, with some kids already lounging on the comfortable couch with plates filled with brownies,

carrots and hummus, and fresh fruit. So many people are making this happen...Katie and Janis (who works in the OIT) are helping the students, big and small, to get everything they want while moving around the large tables quickly so those waiting behind them can get some too.

Before I arrive at the spread, I get engaged in a conversation with one of the groups who already has food.

And when I do finally make it over to the food table, much of the food is gone, at least the homemade stuff Katie has made. Bob Hart's backup food is being put out. I get water – the only thing I really want anyhow. I'm so into the interactions going on around me, I don't want to eat. I can't eat. I'm too excited to eat.

I move back through to the large room crowded with conversations, laughter, and sharing. Returning to the hallway, I greet David Noah, an educator from the Museum of Natural History.

"Thank you for coming! You remembered!" I had shared the event with him and the receptionist at the museum a week earlier when I was returning a number of science boxes, (science teaching resource materials including specimens, books and videos, and other great stuff to teach with).

"I'm glad I could come." David says genuinely but quietly. "It looks great! Really great." He's an artist and a former art teacher, so it's wonderful to hear this from him. I share with him the layout and encourage him to get some snacks too. He asks if he could spread out some brochures and cards he brought from the museum and Bob Hart helps find a table to spread those out. As I welcome Lynn Bryan, a science education professor, I realize it's now 10 o'clock. The official reception has begun – in other words,

people are coming to see the art, besides the fifth graders (the artists themselves) and their partners from early childhood education.

“Y’all, guests are starting to arrive!” I call with my head just inside the copy room turned reception room. “Finish your food and come out to share your work please.”

Turning to Dr. Bryan, I introduce some of the first fifth graders emerging from their feast. “Tabias and Carrie, I’d like to introduce you to Dr. Lynn Bryan, one of my teachers.”

“Hi.” Carrie, who normally had a booming voice in Annette’s classroom, says quietly.

“Can y’all show Dr. Bryan your art and science?” It is more of a statement than a question. But they were excited to do so and both set off with their university partners in tow. I turn to see Annette talking with one of her favorite students and the woman that must be his mother. Annette introduces me to her. “I’m so glad you could come! Thank you for being here this morning!” I say with genuine gratitude. I know it is so important that the kids have their parents see their work. “You must be extremely proud of Roy. He has been a joy to work with.”

“Thank you. I am proud of him. And I’m glad he’s been good.” She glances at his painting.

“Isn’t his art beautiful?” I said. “What do you think Roy?” He is clearly a bit uncomfortable with all this adult attention.

“I really like this painting too. It’s my favorite art thing I’ve ever done,” Roy says with pride.

The hallway is wonderfully loud and busy...people were everywhere. My advisor, Deborah Tippins, calls out my name.

“Welcome, Deborah!” I said as she comes up to me. “I’m glad you’re here! Isn’t this something?”

“Oh yes, it’s great. Lots of art. So where is the science?” she asks in a teasing tone.

“Let me introduce you to Kiara and her university partner Janet. Kiara and Janet, this is Dr. Deborah Tippins. And Kiara, could you tell Dr. Tippins a little about the science in your art.”

I listen briefly to Kiara’s response and move on, knowing it is the fifth graders that are the real focus of this morning’s gathering. I’ll have plenty of time to talk with Deborah later; after all, the show is going to be up until May.

The ‘Bathroom Bonnie’ story: A story within the story.

Before I know it, I’m sharing my mural with both Lindsay and Dominic. I’m so excited that I just kept talking about the paintings, only waiting briefly after I ask them what they think of the way I portrayed them in my latest mural. Dominic says with quiet assuredness, “My hair was longer than that then.”

“Yeah, it was, wasn’t it? I think it kinda looks like you, but I’ll tell you, getting a likeness in painting portraits is really difficult,” I say with enthusiasm. “And what I’m really trying to show in this painting is that y’all are doing it perfect, you’re both doing the drawing exercise perfectly and in doing so, are making careful observations of your specimens, and that’s good science!” The words roll off my tongue because I’m getting

pretty good at using those paintings to talk about my study. They try to not smile but can't help it.

"I guess it does kinda look like me," Dominic says.

"I sure tried my best! Hey I want to show y'all something," I say and start walking away from the crowd. About fifty feet away I stop and point towards two paintings, waiting for Dominic, Lindsay, and their university partners to get there.

"Remember how I wasn't in your class the week after Thanksgiving. I was in North Carolina taking a painting class – all week I did portraits with oil paints." I reach behind one of the canvases to get an 8x10 photo. I pass it to Lindsay, asking, "The painting looks like her, doesn't it?" As the photo is passed around, heads nod as they look from the photo to the painting.

Hot dog, I'm really enjoying the spotlight. As we walk back, I briefly share the rest of my part of the exhibit, from the paintings of local scenes I normally have for sale in restaurants and coffee shops around town, to the images of my field journal and paintings I had done in their classroom.

As I return to the crowds where the students' framed art is displayed, Lindsay hands me the photo of the model looking at her image. Hui Jung asks, "Who is that?"

"Who is that?" I repeat, realizing I've got a great opportunity here. "Who is that, well, that's bathroom Bonnie," I say in a nice loud voice.



Figure 4.24. ‘Bathroom Bonnie’ looking at her portrait at the Campbell School of Folk Art where I had my week-long portrait workshop.

“Who?!” someone calls out. A small gathering is forming as I hold up the photo for all to see.

“See that painting down the hall, that’s the same one in this photo.” As the ten or so people look down the hallway, I finalize my decision to tell the story. I can’t resist this chance.

“Well, this lady here...” I point to the photo. “Her name is Bonnie. When I was taking a class on how to do portraits with oils, she was one of our models in that class. It was a week long workshop. All we did for six days was paint pictures of people’s faces.” I’m really living it up, emphasizing words, making lots of eye contact and gestures. I’m naturally exaggerating a bit too, the workshop only being five days of painting and we did lots of other things that week besides paint.

“Well this lady here, Bonnie, she sat for us for two days. For over 12 hours, she sat almost perfectly still! That’s hard work!” I say, my eyes big. “Well, I wanted to do a

big painting, so I got up pretty close to her, about how far I am from you Hung Gei. And I used that big canvas,” gesturing with my hands length and height-wise to show about a three by four foot size, again exaggerating things a bit.

“So the first day, I painting and painted, really focusing on her face, close up like. And I used a lot of blues, grays, and greens,” pointing to the painting in the photo. “And I’ll admit, it looked a bit frightening, like she was dead or at least really, really old.” I’m really getting warmed up, sweeping my arms and eyes back and forth, engaging everyone I could, soaking up that glorious spotlight. My audience has formed with the shorter fifth graders up front, a number of my university students just behind them, and various others like Katie, who had heard this story multiple times already, and others. Flashbulbs are goin’ off, tension’s a’mounting.

“About half way through our time with Bonnie, she came over to look at my painting during one of her breaks. You know, to stretch her legs, cause she’d been sitting still for five hours. ‘Whoa!’ she said when she first saw it. ‘Hey, you should hang this up in your bathroom at home.’ I looked at her. I didn’t know what she meant but I figured I better laugh. ‘Yeah, maybe I’ll do that,’ I told her, trying to act like I knew what she was talking about. I mean, why I would want to put a large painting of this woman in my bathroom?” with all the eyes and ears I have now, I figure I’ll stretch out the story a bit.

“I’ve actually had some of my paintings put in bathrooms, people will tell me that. I mean, people spend a lot of time in bathrooms, so I think it’s a compliment, a great place to put art, ya’ know? But I’m talking about small paintings now,” again I use my hands to illustrate a size, this one much smaller, about eight by 10 inches. “And this lady, Bonnie, she’s talking about putting this huge painting in a bathroom! That’s crazy! But I

acted like I knew what she was saying because I barely knew her. Well, she goes back to sitting, and I forget about that and go back to painting. That day and the whole next day, I'm working on this painting, sometimes even going up really close to look at her." I act it out with Hung Gei, getting to within a foot of his face and acting like I'm really interested in his nose, bobbing my head and looking like I'm really concentrating... Laughter erupts as he moves back, uncomfortable but clearly enjoying it.

"And my instructor helps me to add more flesh tones, more pinks and oranges. It was looking better. Yeah, the person in the painting looked a little old, but very much alive, very wise even." Again, heads nod in agreement as they study the painting in the photo and the woman looking at it. "Well, that woman, Bonnie, turned about to have a great sense of humor. Cause at first, I thought she was kind of mean because of the expression on her face." I imitate a serious but exaggerated frown and hear giggles from the crowd. I'm getting near my big punch line...what a moment. This reception, this project, my dissertation, my Ph.D. and my career as an educator, boy, if this is it, I LOVE IT.

"So at the end of that second day, we're all looking at each other's paintings of Bonnie, and she's looking with us. I'm very proud of mine, the last painting we did that week. It looked just like her, it was big and realistic and I don't mean to brag, but I thought it was the best of the group, and there were some good painters there! So Pat, the instructor, says some nice things about it, acknowledging that it is not typically the style people would commission. 'The wrinkles and the closeness...people tend to want you to put them in a more positive light.' I shifted uncomfortably, even though I knew Pat and Bonnie were friends."

“So Bonnie says, ‘Yeah, I told Jamie yesterday he should put it in his bathroom.’ I had forgotten about that, but now looked at her, again not knowing whether to smile or what to say...cause I still I had no idea what she meant!”

I pause, letting the anticipation build...letting the punch line have more punch. I know this is good stuff, and I know my audience. When in Rome, be like the Romans. When telling a story to fifth graders, use fifth grade humor. Farts and vomit are good. Excrement is even better.

“What did you mean? Why did she want you to hang it in your bathroom?” DJ asked in half frustration, half excitement.



Figure 4.25. This photo was used on the website and alumni magazine (which has a huge mailing list) and it is of me actually telling the Bathroom Bonnie story. I had just finished the punch line when that photo was taken (photo by D. Paul, 1/16/04).

“Well, we all looked at Bonnie, and she said, with a straight face even, “Yeah Jamie, you need to put that painting of me in your bathroom, cause it will scare the poop out of people.” I stand in this spotlight, soaking it up, radiating from the fifth graders’ giggles at something they think maybe they shouldn’t have heard. Even the moans of the adults are music to my ears, they who just stood through a long story about art to only to hear fifth grade bathroom humor. They loved it, I can tell.

The event is almost over.

As is a habit of mine, I try to get out of the spotlight to end the show with the big punch line. I look down at the 8x10 in my hand and realize I could return the photo behind the canvas. So I do so, moving through the crowd with a big silly smile on my face. After doing that task, I return to the reception to find Pam Taylor, an art education professor.

“I’m so glad you could come, I didn’t expect you to be able to attend,” I exclaim, even hugging her. Receptions make things like hugging seem appropriate, even in a university building with a committee member.

“I wouldn’t have missed it for the world,” she says with a proud smile. “This is great, everything looks fantastic. I’m so glad you’ve done this.”

And she is proud of me, and I’m proud of me too. But I catch myself, saying as humbly as possible, “Well, the students did it all, and it was really Annette that made all this happen. Plus your encouragement and openness to doing this kind of real work for dissertation research.” I’m being honest and sharing my gratitude. As a former teacher, I know how much work it is to educate others, to support others, and how important it is to recognize and show appreciation for those efforts.

But she's not having any of it. "No, this is because of you. All this is possible because of your work. And it is so important, like going across the disciplines. We so rarely do it here, and you've helped me come to Aderhold, come over here and talk about science teaching and learning when I wouldn't do that otherwise. And you've brought art teaching and learning to your department."

Even though I believe it to be true, I shift uncomfortably. But that is another thing that seems so natural at an art reception – to share excitement and compliments.

"Thank you for sharing that. I am really excited about the way this has turned out this morning. It has been a great culminating event – a great end to data collection." I say this with a bit of regret, knowing that I will not be working with these children, at least not as much. I feel so close to them now, looking down the hallway at them answering questions about the art. As I start moving through the crowd again, I notice a woman I don't recognize looking at Roman's piece. Looking at him and then back at her, it's now pretty clear who she is and I want to talk with her. "Hi, I'm Jamie Calkin." I said with my hand out.

She shakes it, saying with the smile of a proud parent, "Hello there, I'm Roman's mom. We were just talking about his work here." I look down at her son, who holds a half smile on his face just enough bigger than his regular expression to know he's proud of all this attention, while a little uncomfortable with it at the same time.

"Isn't it great work!" I say without reservation. "Roman was fearless with the brush and paints. And he sure knows his science too."

“I’m glad to hear that. Yes, he does like to do art.” She says, proudly, but not surprised. “I was an art teacher. Now I work over at the main library here on campus. So you’re doing your dissertation on your work in Ms. Santana’s classroom?”

I’m comfortable talking about academic things, even though I’m a little caught off guard in discussing my ‘research’ with a parent of one of my participants. But that’s the kind of project I want it to be and so I’m excited to talk about it with her. “Yup, I’m working with Ms. Santana to see how we can use the visual arts to teach science.”

“So you want to teach science or art?” she asks, not in an argumentative or accusatory way. Instead it seemed like a question based out of informed curiosity.

“Well, both...really. Both science and art,” I say with increasing confidence. “I work with them during science time, so that’s more important...that they learn the science concepts and processes. But I think they can learn to do some good art things too. So I’m trying to teach both, especially drawing skills and oceanography and geology concepts.”

She nods as if to say, ‘cool!’ Realizing parents always love to hear more about their own children, I reflect on my work with Roman, and share tales of his willingness to ‘get going’ with the art and science activities. “That makes sense that he’s the son of an art teacher. Roman just goes at the drawing exercises, in a really comfortable and skilled way. And he has a freedom with the watercolors that many by his age have lost. So often, kids can get so worried about doing it the ‘right way’ that they worry too much. But he just went at it!”

Roman retains his half-smile, his mom nodding in agreement. Looking at his painting, I remember how he took to fixing it the second day he worked with it. “Yes, this

blue area,” I point to his watercolor. “You did a great job, Roman, fixing this area after the first day when you just started it without planning it. But you pulled it off, don’t you think?”

Roman’s clearly ready to talk, “Yeah, I think it does work now. I really like this area too.”

Both his mom and I nod approvingly. I thank her again for coming and move on. There are so many people that have come, people I didn’t expect would be able to attend...the art teacher at their elementary school and her student teacher, the chair of the early childhood education program, both the professors in charge of the partnership between the university and the elementary school, one of the associate deans and former science education department chair. And I make my way around, thanking them all for coming, introducing them to some of the fifth graders and doing this all with natural enthusiasm and honest gratitude.

At 10:45, I don’t know how she does it in all this chaos and without shouting; Annette has all her students in a line near the hallway’s exit. I thank her for everything, for making everything possible. I realize she kept a pretty low profile during the whole event, clearly enjoying watching her students receive all the positive attention. At the same time, I know she had control of things, that she would get all of her students back to their school safely, and do it in her quiet, but firm way. It is so good to work with her. And as I turn to her students, forming the line, I feel a sense of pride well up in me...I’m so proud of them and I’m so proud to be able to help them shine this morning. “Thank you so much for coming and sharing your talents and learning with us! I’m so proud of every one of you. It has been a great morning for me, and I will see you soon.” While I

know this was the culminating event for my data collection, the official end of my project, I feel the need to continue to work with these students gleaming up at me, who were so excited and so proud this morning. They leave, each one shaking my hand as I thanked them again, thanked each of them by name.

As I walk slowly back to room 220, a deep tiredness seeps in to my body. I had worked so hard for this and I could finally stop worrying, which let the fatigue creep in. For while I did want to keep working with those fifth graders, I felt a huge sense of relief as they left the hallway. Kids wear me out! I put so much of myself into my work with them. I try so hard. But now, it's over...it's done and it was a grand affair. All the details got done in time, all the people and food and art and good talk came together beautifully. And it was documented by more than one talented photographer and I pat my pocket taper recorder – yup, it's still recording. I got the data, I did it. And what a wonderful way to end my collaboration with Annette and her students on learning how to teach science through art.

Conclusions

Returning to Eliot Eisner's statement that introduced this chapter, I hope that the stories in this chapter reflect what I perceived as my successes and failures in working with the students. In many ways, it was a constant challenge to remember why I was really there...that the research part of the effort, the quest to learn more about how to teach science through the visual arts, was not as important as whether or not I had a positive influence on the students and Annette. As Annette said one afternoon in a discussion about the state curriculum and high-stakes testing (and what I saw her do on so many occasions), *"I teach kids, all the standardized tests and the subjects I teach –*

that's secondary. It's about trying to make kids' lives better, helping to prepare them to succeed in the future. That's where it should start and end." As I reflect on my research experiences, those times spent with the students and with Annette, especially when I knew on some level that my presence was making things better, those are the times that mean the most, that I know make it all worth while.

In trying to share those really positive moments, as well as moments when I knew instinctively it could/should be better, I hope to encourage and help readers reflect upon their own experiences to make sense of things in positive ways. It is the vicarious experience, looking at the images above and the stories they and the text told that is the point of this chapter. Each of the four teacher cases and two touchstone narratives tells a self-contained tale. The touchstone events that introduce and conclude this chapter are meant to provide some context into the important issues and revolving tensions of my research experience. I include each of the teacher cases, along with the questions for reflection and accompanying commentary, to help you understand at least one major tension that clearly popped out during the course of the study and was clearly evident through data analysis.

Perhaps the most common tension I felt swirling around my research experience was that my inclusion of art making skills and materials into the science units was not the best way to teach science concepts and processes. A resolution as well as 'worst-case' of this tension was put forth in the introductory touchstone event and case one respectively. In Case Two, I tried to represent how Annette and I worked together to do the best job we could in teaching the students science using art. Specifically, the case is about one way we used artistic means (metaphors and drawing) to communicate and negotiate our

respective roles in the classroom. Cases Three and Four take readers to the arena of lesson plans and unit planning, respectively. It is also here that I try to clarify how the personalities, strengths and weaknesses of the collaborators (Annette and I) interact when faced with the challenges of co-planning and co-reflecting. I conclude these specific narratives with a story about another touchstone event, the reception for our Art and Science Exhibition. It is at that affair that I came to see that my talents and strengths did in fact shine through in the sense that I was able to facilitate positive experiences in the lives of Annette and the students. It is also by reflecting on that event that I can breathe a sigh of relief considering Eisner's statement, for it is a statement that puts some weight on my shoulders, weight somehow lifted by all the things I think happened that January morning.

In Chapter Five, I look across these specific narratives and the other field texts to find schematic narrative templates. In other words, the functions that exist to girder those stories will be discussed by comparing the stories to each other through the lens of my theoretical framework and informed research literature. Evidence to support my claims concerning these schematic narrative templates will also be drawn for the field texts (data collected during the collaboration).

CHAPTER FIVE

FINDINGS PART TWO – SCHEMATIC NARRATIVES TEMPLATES

Introduction

I organized the findings of this study into two chapters – the previous chapter included specific narratives, while this chapter includes schematic narrative templates. In it, I discuss these narrative forms and compare them with the specific stories in Chapter Four. In addition, I present and discuss the three templates I constructed from the research experience. The following data excerpt, while quite lengthy, reflects much about my study, and specifically the three templates I describe in this chapter. It was written about midway through my teaching with Annette and includes three entries in our dialog journal which chronicles many of our struggles to teach science using visual art.

11/5/03 (Annette's Entry)

...I am wondering what you [Jamie] think about what we're learning in science. Would you consider it 'learning science' as an upper level teacher? Do you think we're doing enough? I just want to make sure you feel comfortable with content and movement.

11/17/03 (Jamie's Entry)

Actually, I have struggled with how to respond to your last entry (your request for feedback on whether the students are 'learning science' and are we doing enough). Two weeks ago when I first looked at it, my gut response was 'sure, it's great – great science.' I was very focused on the art techniques and specifically scientific illustration instruction – and I was able

to focus on that because you were taking care of the rest – all I had to do was work with the small groups.

Then my art ed. committee member said, ‘Jamie, you’ve got to focus on science teaching and learning.’ She said this Monday (11/10). ‘It starts and ends there, art is only a means to an end. Unless you want to switch majors and do a degree in art ed’ (and believe it or not, I thought about it for a ½ second ☺) → and that was reiterated at my committee meeting wed. (11/12/03). Since then I’ve thought some on it. One thing that strikes me is that I have always been a little conflicted in the following ways:

#1 – I’ve always been most interested in issues like self-esteem, interest, the process and the fun activities, the big picture (not specific science concepts) and making connections between science and other things (like art).

#2 – I’ve never really been satisfied with my own science teaching. In part because there’s pressures that work against my #1. But also, I think unconsciously, subconsciously, and sometimes consciously, I define science in rigid terms – i.e. science is what is done by ‘research scientists’ at labs and universities. In a similar way, I believe that I myself have only ever done ‘real science’ in a couple of classes (Masters level science classes at NC State). The rest of my time has been spent learning about science – either by studying science concepts or by copying and replicating what scientists did (learned in the past – often the distant past).

So I’ve never really been happy with what my students did ‘in science’ → At least compared with what that little voice in my head was saying about what ‘real science’ is.

I’ve thrown a lot out there – where do you agree and disagree and how are some of your ideas similar and different?

11/18/03 (Annette's Entry)

Hmm. I can say I am not always happy with my science teaching either...especially this year. It's hard to squeeze everything in especially with these crappy standardized tests. The stretch pulls everything so thinly that no one gets anything really satisfying – we can see through what could be. We make 'learning' the illusion. The reality is the – crap...to put it mildly.

I guess self-esteem and personal interest – no I know – used to be a bigger part of who I am as a teacher but I see this being eroded away by the “pressures” of teaching. I am definitely more cynical about some things and more sure that I won't ruin anyone's life by grading – fairly – things with bad grades because they didn't do the work.

** ANYWAY – aren't the big pictures science [referring to digital photos pasted into the journal, like figure (Dominic/Lindsay)] – does it need to be so specific? I don't think so at 9 or 10 years of age. What is 'real science'? What is something you've done that is real? Give me a verbal picture.*

The excerpt above was part of the written dialog I had with Annette that took place around the midpoint of our co-teaching experience (spanning from the middle to end of our second of three units). It represents a number of different currents running through our collaboration, including ways we communicated, perceptions of our own teaching and how we related those perceptions to our work together. The interchange demonstrates how we view science teaching and learning as well integration with the visual arts. The specific narratives, or stories, in the previous chapter represent many of the stresses we were feeling as we wrote the entries above. Those entries also illustrate the larger tensions that underlie much of what was done and learned in the study.

In this chapter, I turn to those broader tensions representing wider elements of the ways Annette and I worked together to plan and teach science units using the visual arts.

I present three *schematic narrative templates* in the form of tensions. As schematic narrative templates, the tensions explain how Annette and I recreated our experiences in specific narratives like those in the previous chapter. Wertsch (2002) notes that the connections and themes between peoples' stories can be boiled down into frameworks that are unconscious to the storytellers themselves. Another way to put it is that those frameworks, the schematic narrative templates, structure the way people have experiences and how they transform experience into stories (stories = specific narratives). For example, within the subculture of elementary teachers, students and community members in Casay, Philippines, the "place of place," symbolizing deep connections to the land, constitutes one of the schematic narrative templates in how stories about science education were represented by Tippins, Nichols, Morano, Bilbao, and Barcenal (2005).

Wertsch (2002), in presenting how Russians had a "triumph-over-alien-forces," again describes what he means by schematic narrative templates in the following:

...Narrative form is taken to be a cultural tool for grasping together a set of events into a coherent whole. The particular way of grasping together actors, motivations, events, turning points, and so forth can be expected to take on particular forms in particular settings (p. 88).

As I struggled to 'grasp together' the things in my study, different templates were constructed and deconstructed. The templates included in this chapter are most related to the guiding questions, and fit with what I understood as Wertsch's notion of templates.

I also draw on the work of Tippins, Nichols, and collaborators (Arellano, et al., 2001; Tippins, Nichols, & Wieseman, 1997) to support the notion that tensions can be used to inform

and represent the complexities of classroom teaching and educational research. Specifically, tensions (in contrast to themes) represent the multifaceted and shifting nature of our collaboration. As discussed in Chapter 3, tensions can be productive and positive, as well as the typical perceptions that they are negative and detrimental. How we co-planned and co-taught science using art; thus, how Annette and I made sense of it can/will be explained in terms of schematic narrative templates. Tensions sometimes pointed me to dichotomies instead of complexities. In other words, tensions do not always resolve the temptation to oversimplify.

Compared with the specific narratives of the previous chapter, these schematic narrative templates are presented less in storied form and more in expository ways. Specifically, data excerpts are included to provide examples and support for the claims that these templates explain the ways I (and to a lesser degree, Annette) made sense of the experiences we had as part of my study.

How the templates were constructed

It took some time to construct the templates. After repeated readings of the field texts (data) and specific narratives, I found the best way to generate the templates was to start by looking across the stories, asking ‘Based on my guiding questions, what do I claim as successes and failures? Framed another way, what do I perceive as the facilities and impediments to teaching science using art and collaborating with Annette?’ In fact, I first thought this was a template in itself. That is, I saw my experiences as part of a series of successes and failures, and that I needed to have failures before I could have successes in teaching.

I even had a title for the template – “perceived successes require perceived failures.” Instead, I have found that the research questions are framed in a way that leads to claims about successes and failures – that when I wrote the specific narratives, I was writing stories that

specifically answered the guiding questions in terms of things I thought went well and things that didn't. But instead of a template in itself, the tension between finding successes and admitting failures lead me to some of the real roots of my stories.

In other words, templates were constructed by exploring answers to the following questions, 1) What is behind or underlies the perceived successes and perceived failures I claim as answers to my research questions, and 2) What are their sources or causes? This construction occurs during the course of writing and reflecting, reviewing field texts, consulting my advisor, and briefly revisiting related theoretical research (Wertsch, 2002; Girod, 2001; Glassman, 2001).

As I tried to articulate “perceived successes require perceived failures” as a template, I soon became convinced that it was not so much a template as a “tool” to generate templates. That is, what explains my perceptions of successes and failures in terms of the activities themselves? What I found was a strong personal preference to scientific illustration. In fact, it was fair to say that I believed that it was *not good* science teaching using visual art *unless* it was scientific illustration (in terms of processes and products). So I thought I had a template. My revised template was, “I believe scientific illustration is the best way to teach science.” This belief was also a bias going into the study. It also surfaced as a tension during my teaching. But in terms of a template, this bias or belief fails to explain the root of what connects my specific narratives. Why did I believe that scientific illustration was the key tool for teaching science using visual art? Answering this question led me to a very disturbing template (template #1). Fear not, however, for based on a hard look at this template, great hope is found for our hero in the final chapter (Chapter Six – Implications).

Personal vs. cultural templates

These templates were personal, compared with the cultural templates Wertsch (2002) and Tippins and Nichols (2005) found across many similar stories shared by numerous people of the same cultural group. To find the cultural templates is beyond the scope of my study, but I will allude to possible cultural templates, especially as they interact to form tensions with my personal templates.

One more disclaimer

While the three templates I describe in this chapter do explain a lot about what happened in the study, they do not explain everything. There was simply too much that happened and too many tensions and undercurrents to be included as part of this study. For example, a lot of the pragmatic and logistical issues had large impacts on my work with Annette, but are beyond the scope of the study. Specifically, classroom management and time constraints were fundamental to classroom events but are not directly included in the templates.

The three narrative templates I created through analysis of the data and specific narratives (see Chapter Three for more on how that analysis was done) are as follows: 1) a limited view of what counts as science requires scientific illustration as the key “tool” to interdisciplinary science and art teaching/learning, 2) Jamie Dewey co-teaches in Annette Vygotsky’s classroom, 3) finding balance through the co-planning and co-teaching process.

Template One: Our views of science determine our tools for teaching science (using visual arts)

When the cards were laid down, I defined science in a very limited and orthodox way. It was difficult to admit this, even after it became so clear through much analysis and writing. Specifically, my view of science was limited to the products and processes of ‘research scientists;’ in other words, framed within a Western cultural perspective. What I considered

science was restricted to what ‘working scientists’ did at work. My stance, while mostly unconscious, dictated that school science rarely fit within this definition, especially elementary school science. Furthermore, the only branch of the visual arts that I considered science was scientific illustration. In short, my story is one of a teacher with unreachable expectations resulting from an orthodox and impractical view of what counts as science. For example, in the dialog journal excerpt at the beginning of this chapter, I defined science as, in my experience, the kinds of activities limited to graduate school science courses.

On the other hand, Annette had a much broader view of what constituted science. Therefore, what she considered appropriate science ‘doing’ and ‘learning’ by the students was much more realistic in terms of what the fifth graders were producing from our units. Likewise, Annette viewed more types of visual arts as valid ways of knowing science, compared with my restriction to scientific illustration (as will be described in detail below).

My limited view of what I considered science (as I wrote about in the dialogue journal except at the beginning of this chapter) formed the basis of many of the tensions in the stories of my experiences in Annette’s classroom. In other words, it forms the template that explains the root reasons for many of the ways we perceived successes and failures portrayed in the specific narratives in chapter four.

It is not unexpected that the number of perceived successes I found in my teaching science using visual arts was very low when contrasted with Annette’s perception of the same teaching events. Specifically, the introductory touchstone event is a story about the only activity I did with the students in which I felt I was really successful teaching science using visual arts. However, even that activity did not meet my expectations, especially when I compared the

students' science journals and the things they said during that activity with what I wanted them to do and learn (that is, be like scientists that do their own illustrations).

Viewing science as dichotomous or more complexly

I introduce a teacher case by Michalinos Zembylas (2002) to explain why I believed scientific illustration was the key tool for teaching science using visual arts compared with Annette's more open view. His story is about an elementary teacher who succeeds in infusing emotion and excitement into her science teaching and her reflections on her teaching. Before discussing how the teacher in the case succeeded, Zembylas introduces the tensions she grappled with in teaching science the way it was often understood by our culture and in our schools, describing it as follows:

“Science was (and still is in many ways) a rationalist, intellectual endeavor of finding the most appropriate concepts and theories to describe and explain our world. And part of good science teaching has required teachers to think about their work in terms of the great dichotomies: either science facts or feelings, rigorous and objective scientific evidence or personal and biased emotions (“demons,” as many philosophers describe them). Zembylas, p. 186).

This quote very much resonates with my own experiences as a science teacher and specifically in this study. Especially relevant is that like a dichotomous key, in trying to identify ‘good science teaching,’ I always picked the former over the latter in Zembyla's choices, failing to integrate the ‘demons’ he refers to above.

In the commentary to the case, science educator Megan Boler (2002) cites science historian Thomas Kuhn in describing how science has taken on the myth of being “reified as an

objective, unquestionable authority on matters of nature as well as culture” (p. 188). She continues

According to this myth, science does not involve bias, subjectivity, or emotions. The myth deepens on value laden dualisms central to Western thought – dualisms such as mind versus body, reason versus emotion, fact versus fiction, male versus female, and good versus evil (p. 188).

Boler applauds the veteran teacher in the case for taking a broader view of science than the myth she describes above. Indeed, the teacher in their case found some resolution in finding the connection between emotion (positive and negative), science, and teaching science. However, my experiences during the study were marked by a sustained undercurrent of frustration when I thought about what Zembyla’s notion of ‘good science teaching’ requires us to think about. Conversely, Annette seemed to be more at peace with our science units. In the next sections, I provide links between our respective views on what counts as science with data and explanations on how they fit within perceptions of our teaching.

My limited view of what counts as science:

What led to my frustration? To find data on my beliefs about what counts as science, I didn’t have to go far, just to some of my writing about my subjectivities. Going back to the beginnings of my study, I wrote the following:

Especially as a graduate student, I have ATTEMPTED to extend my definition of who is a scientist and what counts as science...What does it mean to DO science? I like to think that I would answer that question, ‘Anyone who is learning about natural phenomena is doing science.’ Recorded 5/21/03 – subjectivities writing before study.

My ‘attempt’ to define science represents what I thought it ‘should be’ as I had learned in graduate school. It was also what I would have said would be the gauge to judging success in teaching science. Even so, when I thought deeper about what counts as science I admitted something quite different.

...But somewhere deep down in my gut, I still often think that SCIENCE is what SCIENTISTS do or what is described in science textbooks and that students are just learning about science when they ‘do science’ in public school classrooms. It’s like kids ‘playing doctor’ – in classrooms, they’re just ‘playing scientists.’ Recorded 5/21/03 – writing about my subjectivities before the study.

This excerpt was written near the end of my initial writing on subjectivities. It reflects what I really thought about school science, which was extremely negative compared to my view of ‘real science.’ It was a bias going into the study. And even though it was identified as such, this bias unconsciously under-girded a lot of what happened during data collection and early phases of data analysis during the study. It was only in the last phases of analysis that my bias re-surfaced in explicit terms (as I scratched my head, realizing how few real successes I experienced in teaching science). In many research methodologies, this would be a serious problem in that a bias identified going into the study played such a big part of the study itself. However, due to the exploratory nature of this study, it is only appropriate that deeply rooted beliefs of the teacher-researchers would play out in so many ways. In what follows, I continue to explore data that points to those deep seeded beliefs and their impact.

Acknowledging my limited view of science makes it clear to me now why, in recent years, I perceived myself as a bit of a ‘rebel’ within my own discipline. Even though I was a former high school science teacher and Ph.D. student in science education, I believed much of

science teaching and learning was irrelevant, not just for me, but especially to the majority of public school kids. In the following excerpt from my research journal, recorded in between units one and two, I ask myself some hard questions.

Is 'knowing science concepts' really not that important to me? I say misconceptions don't bother me? Really? Why/why not? What does bother me in science education (i.e. what do I want for the students?) 9/17/03 Memo in research journal.

This memo illustrates my internal grappling with the results of a limited view of what counts as science. I know somehow that it is at odds with active engagement and excitement with science ideas and materials. While I was not able to put a name on it (I will in template three below), I knew some things in science teaching were more valuable to me than identifying students' misconceptions and changing them (conceptual change model of learning). However, I ultimately perceived that the quality of science learning, and therefore science instruction, were best judged in relation to 'correct' processes and conceptions within the canons of Western Science (as I knew it). In other words, I was influenced by the 'pressures of my own accountability'. Before looking at how accountability impacted my perceptions, I turn to Annette and present the results of my analysis of 'what counts as science' from Annette's point of view.

Annette's more pragmatic view of what counts as science:

As we began our co-planning together, I noted to Annette that she seemed to love teaching science. She agreed that it was indeed one of her favorite subjects to teach (along with reading and creative writing). As I noted that so many elementary teachers would not count science on their list of favorite subjects to teach, she said the following.

My college experience in science was great. I went to a little liberal arts college and we had great courses, plus we had to take a lot of everything, no just stuff in our major. I

loved my science courses and since then, it's always been one of my favorite subjects to learn about and to teach. (6/3/03, Conversational interview)

After I shared with her how I thought that was unusual among the elementary education majors I had known and taught, she replied, "I think it is typical for teachers to get excited about learning different things. One of my things is science." She then explored how her own definition of science was related to her interest in teaching it:

Science is about exploring nature and natural things and getting your hands dirty. It's about doing experiments, even when it is a kid's experiment, if it answers their real questions, that's science. Science is so easy to relate to their lives and things their interested in. It's much more fun to teach for me than things like history, blah! I don't know, science has always been easier for me to teach. Maybe it's because I like it so much and I know more about it than the stuff I've got to teach in social studies.

(Conversational interview 6/3/03)

There is a sense of freshness and excitement in Annette's approach to teaching/learning science, as illustrated in her statements above and the picture below. In another example, she ends one of our dialog journal entries by wondering 'out loud' about a class reading about deep water oceanography.

In addition, Annette is much more pragmatic than I am about planning and about finding success in science teaching, as her comments that follow show:

Planning comes naturally to me and I realize that it does not for everyone. My goals for the year include teaching/introducing QCC's and trying to make them interesting while providing proof for higher ups that I'm doing my job (without obsessing about testing which unfortunately is consuming 'education' now). I don't have a problem with people,

you, planning differently or not at all as long as we get ‘proof’ of getting things done. I’m not worried about our different styles. Annette’s entry - Dialog journal 6/9/03 – early in first unit together



Figure 5.1. Annette pouring water on sand to illustrate the effects of rain and erosion. Students carrying out their own ‘experiments’ after brief instructions and a demonstration from Annette.

As far as she was concerned, all that was needed was ‘proof of getting things done.’ With her toolkit from her nine years as a classroom teacher, she was adept at assessment, especially in writing. But more importantly, Annette was more open to ‘finding’ proof that the students had learned science because what was needed was not as limited as what I demanded. To look further

into the impacts of our respective views of science, I introduce the following as ways we differ:

1) accountability, secondary vs. elementary science and 2) our different realities as science educators.

Secondary vs. Elementary science

One of the possible reasons for our differing views on what counts as science was our different backgrounds in terms of the levels at which we taught science. In the following excerpt, I am writing to Annette in our first dialog journal near the end of our first unit teaching together. It reflects an occasional dialog of ours throughout the study about the differences between secondary science teaching and elementary science teaching.

Someone in my department said that if you really want to learn how to teach (science or any subject) or how students learn, watch and learn from an elementary school teacher. I think that in the secondary sciences, we can worry too much about 'correct' science, and getting to lots of science concepts → so much so that we lose track of what is important to the students, what is interesting to them. I think we (in the sciences) also are so interested in the science concepts and processes that we go overboard – because it's human nature to teach what you're excited about yourself – but the polarity of water molecules may not be all that exciting for 5th graders. 6/16/03 dialog journal one.

Even during the study (this was written in the middle of unit one), I was aware of my limited definition of science, at least compared to what Annette considered appropriate for elementary science. In my journal entry above, I am hinting at the problems of narrowly defining science to only include 'correct science.' Even so, I was not aware of how much of an impact it had on my whole outlook. In that entry, intuitively I'm aware of what good science teaching and learning really is; it is not getting wrapped up in my narrow definition of science. Even so, when

push came to shove, I could not help but judge teaching events by that narrow view. And if what counted as science is limited, what counted for the science learned using visual arts is limited as well.

Annette somehow managed to keep the freshness, the curiosity and excitement of learning and doing science for her students. One of the first times I really interacted with her students was when she encouraged me to help them with their science experiments. It was after I had observed in her classroom a few times, sitting at her desk, keeping to myself but watching everything. The students were in small groups, using toy cars and ramps to answer their own questions about weight and momentum. I remember thinking and even asking groups to “define the control variable.” After thinking about all of the ways their experiments weren’t science, I remember catching myself and reflecting on how excited they were and how many things they were doing that was science. So often it is easier to find successes when we observe others compared with our self-perceptions of our own work. In part, I think this contributed to my perceptions about successes and failures in teaching science. Even so, I often found that Annette, an elementary teacher, was more interested in teaching science than me, a university science educator, and former high school science teacher, who just wants to teach art.

Our different realities and our view of science

Accountability

I was accountable for my science teaching in different ways than Annette. Foremost was being accountable to myself. And I had the time and energy to challenge my own notions, as the above memo illustrates. That is a luxury most teachers do not have. The fact that I had the luxury of honestly asking these questions of myself points to one of the facilities in the study – my role in teaching science was often not under the scrutiny of traditional forms of accountability...that

was Annette's job. Comparatively rare (but jarring to me none the less), was when people, after hearing about my dissertation topic, cocked their heads and asked, "Well, what science did the kids learn? Did it work?" I always had difficulty answering those questions.

To illustrate my point, I can remember some striking situations. Perhaps the one in which I was hardest on myself was my '10-second chance' - I happened to be introduced to Tim Rollins, a prominent artist/art educator. He commented on how he was working with some scientists at University of Pennsylvania on how art related to astronomical physics when he heard about my study. After that, one of my committee members prodded me, "well, tell us about what you're doing." After stammering a bit, I stuttered, "We set up a fish tank in my class today." The conversation broke up and I cursed myself, "That's the best I could do!?!?" But even though I had already taught one unit, my perception of what 'real science' had been taught was limited and therefore, it is no wonder that I struggled with a remark to equal astronomical physics (excerpts taken from personal conversation, 10/21/03)

In many other instances, I strained to generate examples of how the students in my study had actually learned science through art. Specifically, two come to mind; one for a university press article about my study following the reception, the other for a practitioner-oriented article I worked on with my advisor. In retrospect, it was my limited view of what counted as science, not that my teaching was such a failure, that lead to these situations. Specifically with the university internal press article, I remember struggling with specific things to say about the science learned by the students during an hour-long interview with the journalist, a former reporter for our local paper. In the article, my only quote was, "The students found talents they didn't even know they had." Since the article was intended to put the exhibition reception and my study in a positive

light, thus making the university look better, my statements about how I could not see how my teaching resulted in any science learning were not included in the article.

Annette had a very different set of experiences in terms of what she was accountable for with her science teaching. Foremost, she was accountable to the parents and administrators in ways every teacher is familiar with – grades and feedback reflecting the students’ science learning (just one on many subjects). Annette felt pressure to teach any science terms or concepts that might be part of one of the numerous high stakes tests the students took while I was there. This was especially true since her school’s test scores were under great scrutiny and teachers felt a lot of pressure to improve them. For example, Annette noted we still needed to teach the words habitat and ecosystem after I explained the difficulty in differentiating them, at least for a fifth grader. “Yeah, but both those words could be on the stupid test,” she said wearily, referring to an upcoming standardized test.

Science terms and science talk as examples of accountability

In reflecting on what science was taught during a drawing activity of ocean animals, I tentatively note (with a hint of tired frustration)...

I think I used some words in terms of the science that they learned. Fins and dorsal fins. Rows of teeth (in sharks), etc. Mostly again it was about drawing techniques. Annette worked with the rest of the class. Audio Journal 11/13/03

‘Using science terms’ is not science to me, nor is it doing science. To add to my frustration, the drawing activity (using grids to draw from pictures) meant students were not drawing from life either. The science materials were books, not living things. So to me, the drawing activity was not *doing* science.

While Annette may not have considered teaching science terms as ‘doing science,’ she did find the process important, especially when introducing new units. Upon hearing that I would not return from a workshop until after she had set the date to start unit one, she noted:

Actually, that will be good...I can spend the first couple days before you get back introducing the concepts before you start. We'll define some of the key words in their science journals. And that way, they won't be totally lost when you use those words.

(6/2/03 conversational interview, pre-unit one)

When I asked if she usually started units with a discussion of key vocabulary, she said, “Mostly, because it’s amazing how frustrated they get if words seem to them to come out of the blue. And then they’re grumpy and say “I never heard that word,’ I just tell ‘em they better look it up in their notebook.”



Figure 5.2. Annette discussing science vocabulary (on the flipchart) with the students

University science experiences vs. the people who don't know kids

Annette and I had very different realities as educators, even as we shared time and teaching together during the study, both in terms of accountability discussed above, and in terms of experiences. From the dialog excerpt at the beginning of this chapter, I noted how I only did ‘real science’ a few times in my master’s work at NC State. I shared the ‘verbal image’ Annette asked for not in the dialog journal, but during a conversational interview during recess after reading her journal.

It was in my aquatic invertebrate courses. I did two ‘experiments’ where I had to do a literature review, and go through a whole experience for each. We had to systematically write them up, just like the articles we cited. It was very fancy. But one thing that did surprise me is how much guessing you really had to do to get from your ‘results’ to your ‘conclusions.’ Anyhow, it wasn’t anything like high school or undergraduate science classes (11/20/03, Conversational interview).

My notions of science experiments were probably more orthodox based on my ideas of what counted as ‘correct science ideas,’ that is, scientific conceptions. But in retrospect, there are good reasons for it, on top of my graduate science coursework. While in my PhD program, I was part of a tour led by a horticulturalist in charge of caring for the plants in numerous greenhouses used mostly by the botany department on our campus. His knowledge of the plants was impressive, as was his experiences in learning how to keep the plants healthy. While discussing the work of some of the botanists who worked in his greenhouses, I asked him if he considered himself a scientist. We were all caught off guard by his immediate and confident response, “No, I’m not a scientist and this isn’t doing science. Science is what those professors and grad students do in here, with controlled variables and quantifiable measurements and results.” I thought to myself, ‘Huh, if he’s not doing science, then I’ve surely never done it with my students.’

My most recent experiences with science in a university class came in the influential scientific illustration course taken during much of the study (August-December, 2003). And even though I saw so much in the way of science learning in the class, the instructor saw it differently, claiming it was an art course, and definitely not science. He insisted that he was not a scientist but an artist and we in the course were learning illustration. The science was learned in the

required courses of the program well outside the realm of the school of art. A classmate of mine from the course recently corroborated that when I saw her in a local coffee shop, holding up her genetics book to show what science was really (personal conversation, 1/27/03).

In addition, I have had a lot of experiences critiquing school science in my years as a full-time graduate student; for example as a student teacher supervisor or second hand in analyzing the science education literature. However, I knew from first hand experience that there was a difference between knowing what real science looks like or even what it could look like in schools, and being the classroom teacher that facilitates that science doing. Two difficult teaching experiences as a high school science teacher and two additional stints as a graduate student had not resolved for me what seemed like an unlikely paradox – that what kids did in school science was very different from what scientists did in science. Perhaps, I thought, elementary science offered hope, not in doing sophisticated experiments with the kids, but by not being bogged down by all the ‘correctness of high school science.’ Even so, I brought this baggage into the study.

Annette, on the other hand, had different experiences with science (as discussed above) and certainly seemed to have less baggage concerning ‘school science.’ On numerous occasions, she claimed that the people who write the curriculum often knew very little about kids or even teaching. In this way, perhaps she was able to discount any ‘experts’ view of what should count as science in her classroom. Instead, her own positive experiences with science seems to translate directly into what she counted as science; and that meant, among other things, that what her students were doing counted too. In a particularly poignant example, Annette did not pick up her students’ science books until, after many months, someone in the office called her on the intercom with the oversight, adding, “The students should have already had six weeks of science

instruction.” Annette replied, “Oh, they have, we just haven’t needed the textbooks yet, but thanks for checking, I’ll have some kids come down to get them tomorrow.” (as recalled by Annette, conversational interview, 6/19/2003). When I asked her for more details, she said nonchalantly, “I don’t need a textbook to tell me what science is or the ways to do it. And I can show the kids that better without it. We used the books eventually...as a resource.”

The experiences with a friend of mine in the art world represented a bridge between my university experiences and my work in public school classrooms. As can be seen at first glance, the following excerpt (from my audio-journal) represented another example of my claim that school science is not real science.

Again I think of Robert Lowery’s (an artist friend) statement that art provides a person with their own unique language. And they can use their art to communicate things, including science. I have come back to it so often as a rationale for using art and science. Because science is not classroom science. School science is not real science and attempts to make it like real science, while important, are still only attempts. They are not usually accepted as generating scientific ideas; creating new knowledge. It is so much more about validating knowledge already created by those before us. 10/10/03 Audio Journal.

Again, I lament on differences between what I see as school science and ‘real science.’ I introduce my claims with an interesting statement about one of the values of art from a local artist, Robert Lowery. Robert is about my age, and is a full-time artist working mostly in photography. He hated science in school. Yet, he is also one of the most curious people I know, learning about everything, including science, around him with a youthful zest, an artful zest.

After multiple hour conversations with Robert about my study, I started to wonder, “Why was he so interested in my study?” I then asked myself why he was so excited about science,

especially after hating it so much all through school. Based on my own experiences and views, I decided his enthusiasm for science derived in part because he defined it much more openly. It was a dreadful view I held – the problem with school science was that it wasn't real science, but no one but working scientists *do* real science. Ironically, it was a professional artist who showed me an example of overcoming this paradox in his own story of life-learning. While I spent hours talking to Robert on his porch about science (and art), Annette lacked such luxuries (at least from what I had seen of demands on her time).

Annette and I clearly had different realities in learning, as well as teaching, science, even in terms of the three science units we co-taught together (which I wrote about often in Chapter Four). Annette's world of science teaching was marked by time crunches and classroom management constraints, just to name a few of the difficulties she faced daily. And within those stresses, she also had to be aware of the need to prove to, as she put it, "the higher-ups," that her students were indeed learning science. Even so, she maintained an overall view of science more appropriate than my own view. In the next section, I turn to the impacts that our respective views of science had on our use of the visual arts in the teaching units.

Support for our views of science pointing to the different ways we see visual arts to teach science

If I had a limited view of what I considered science, it is no surprise that my view of what I considered an effective tool to teach science was also limited. In the same way, Annette's broader view of science lead to a broader view of the possibilities of teaching science using visual arts. From the start of my work in her classroom, Annette was open to my insistence on using visual arts to teach science. After school, as we prepared to teach unit one, she reassured

me that she valued my efforts in exploring the connections between art and science with her students.

Your work in my classroom is important. The way I see it, teaching the students how to draw or paint or whatever; it's just another way for the kids to express themselves.

Whether it's in science or whatever, the more tools they have to communicate, the better.

(6/3/03, conversational interview)

She went on to describe how one of her difficult students got in trouble for losing his temper, because, as she describes it, he was “unable to express himself.”

Her perspective that the main value of teaching science with visual arts is that it offers the students another tool to express themselves, echoes what Robert Lowery considered the true value of the visual arts for both kids and adults. This belief is also consistent with the views of two elementary teachers, Karen Gallas (1994) and Karen Ernst (1996). In the following excerpt scanned directly from our dialog journal, Annette saw a student she had been concerned about that, in the photo, was really engaged in his work.

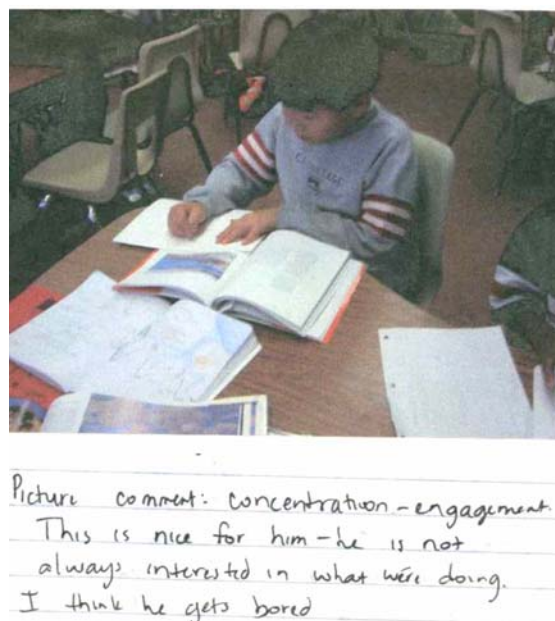


Figure 5.3. Annette comments on a photo pasted into our dialog journal.

In contrast to Annette's belief that there are many reasons visual arts offer hope in teaching and learning science, my belief was more exclusionary. To me, scientific illustration was the only really appropriate tool for teaching science using the visual arts. In the following audio journal excerpt, the first statement reflects my insistence on using visual arts. I then pondered a conversation I had with a classmate and visual arts major and how it related to my own study.

I have a certain subjectivity – “art is a good thing” – in scientific illustration class – there's a painting major who said that s.i. is different from her painting classes (where she's rewarded for doing the total opposite of what the instructor said), whereas in scientific illustration there are correct ways of doing it. It is a communicative act, you are communicating something and that something is a scientific method, therefore there are correct answers and there are misconceptions that are wrong. How does this relate? How does that relate in how I try to use visual arts to teach science? Where does creativity come in and possible misconceptions or alternative interpretation? 10/8/03 – audio journal

The conflict between how to teach science-art and the more interesting painting approach lead me to some thought provoking questions. Unfortunately, those questions did not, at that time, lead me to an awareness of the root causes of many of my struggles...to this template.

It is only well out of the field that I can look at excerpts like the one above and immediately know what the key statements are to be underlined. In this case, the sentence that is underlined points to my limited definition of what counts for science, what is 'a scientific method.' That method I speak of is observation, of looking closely at things. Specific to visual arts in fact, it falls within canonized scientific methods. For example, field sketching (see *Art of*

Field Sketching (1995) by Clare Walker Leslie) forces the scientist-artist to observe things closely but also quickly, in addition to allowing for records of those observations.

Using drawing as a scientific method was also part of the state science curriculum. Throughout the study (and earlier), I clung to the one state curriculum objective that related to my goals in this way: “make sketches to explain ideas” and “makes and keeps records of observations.” Both were in a ‘laundry list’ of things students were to ‘be able to do’ using scientific methods. However, drawing to make/keep observations as well as explain ideas fit directly with the tenets of scientific illustration, as underlined above. I know this for it is what peaked my interest when I listened to my scientific illustration instructor speak of the goals and uses of our work in his class.

In the next audio journal excerpt, I record my thoughts about teaching science using art while at the same time, actually engaging in the process myself. I am sitting on the grounds of the state botanical gardens, sketching a tree (Figure 5.4 below) during scientific illustration class while recording the following.

I am drawing the habit of the river birch. (Habit is a specific type of scientific illustration). I was thinking about Meriwether Lewis that I’m reading about and how he was so motivated to do this kind of study partly because he was the first (in his mind) to study some of the plants and animals he sketched. To study them in this way in terms of Western Science and how he felt a great need to share his knowledge...that it was important to know and these things are something I think science experiences lack. I was thinking about the fifth grade class and whether I could convince the students that they really need to do this for science and I do not think it is a valid argument in terms of adding to science. So why do it? I think one reason for doing this kind of drawing is that

it ends up being very much yours that it is very personal and that its science related in terms of the same types of knowledge, products and science processes. 10/10/03 Audio Journal.



Figure 5.4. My finished ‘habit’ drawings of River Birch with (right) and without leaves (left), ink on vellum film.10/2003.

Above, I articulate nicely the rationale for using drawing, and specifically field sketching, to learn about science (natural history). The line drawings add to that justification; for example, I was forced to study the structure of the trunk and branches to render them accurately. However, I limit what counts as science and doing science in that I stated products must ‘add to science’ and to scientific knowledge. But at the end of the excerpt, I note the power of drawing rests with making something one’s own. Ownership certainly resulted in this exercise; it may not be new scientific knowledge, but it is clearly new to the artist. As Franck (1973) notes, “Drawing is the discipline by which I constantly rediscover the world” (p. 6). Each object that was insignificant became significant to the artist, and each time drawing it is like drawing it for the first time, according to Franck.

Really drawing, or what Franck calls ‘seeing/drawing’ offers both challenges and benefits. I worked diligently to help the fifth graders do this, not in simply recreating symbolic drawings of things but rendering what is really seen. An illustration of this comes from comparing the fish in the diagrams the students drew with Annette with drawings by those same students drawn from preserved specimens in jars. I continually encouraged the students to look at what they are drawing, expressing many of the same values of drawing/seeing as Franck (1973), Nicolaïdes (1941), and Edwards (1989).

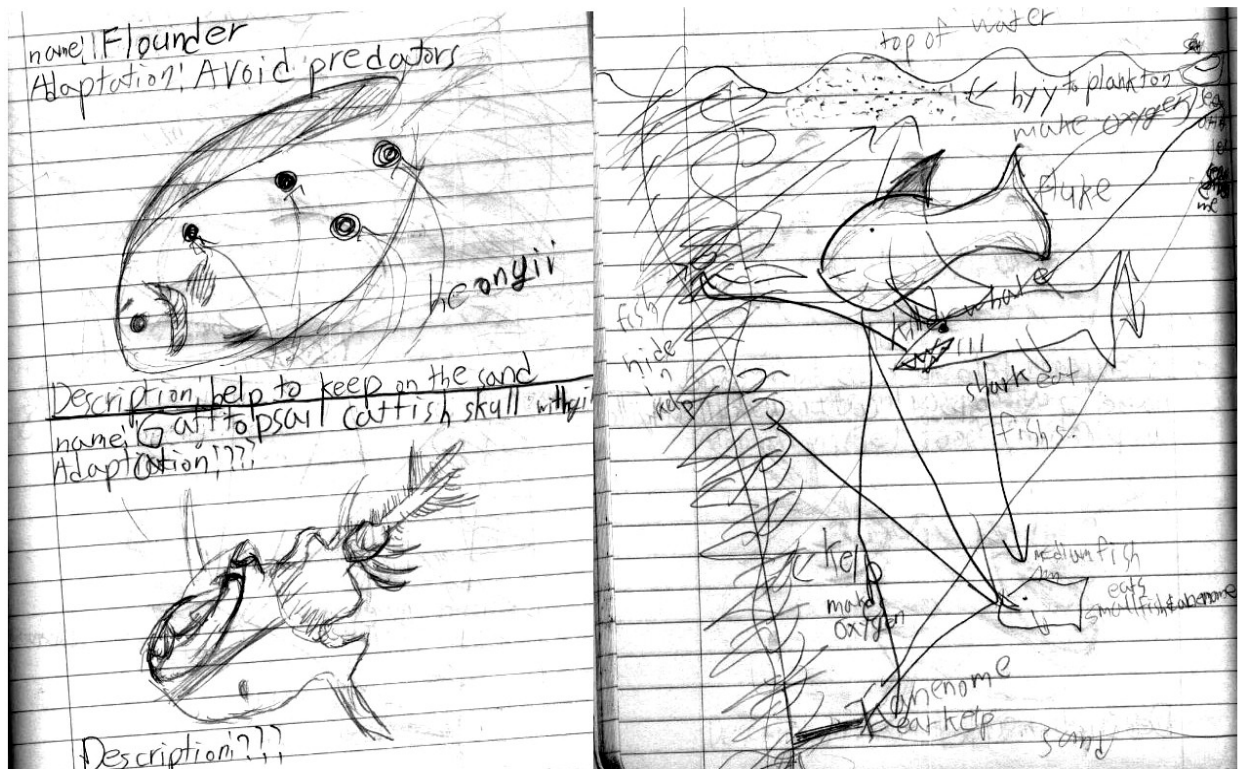


Figure 5.5. Hui Jung’s drawings of fish done without specific art instruction (right), compared to drawings with instruction (left).

Indeed, I held clear limits about how good art could be used to learn science, including the following: 1) drawing actual science objects (not from pictures), 2) drawing as you see (observation), and 3) communicating real science in illustrations.

The following excerpt from my Audio Journal illustrates my belief that scientific illustration is the natural tool for me to use to teach science with the visual arts. It covers a period (in planning for unit three) where I struggled to use more than just scientific illustration in teaching science.

I need to look at the state curriculum goals for earth science and really start thinking about how I can integrate art into that unit (on landforms). I have been resisting a little bit but it is where I need to shift gears and start to move away from naturalist type drawing that leads to drawing animals and towards more types of art materials and skills that fit into the subject matter of my teaching [in this case, geology-earth science]. That is hard for me for a number of reasons. Scientific illustrations are what got me into art – to do naturalist drawing to replicate nature or render animals in class. I was drawing plants today in scientific illustration, from a photograph and from life and I like drawing from life so much better. AJ 11/17/03

This is another example of my bias and its roots – for I revert back to scientific illustration even after telling myself I need to look beyond it. In fact, it was only through the encouragement of my advisor (and to the relief of Annette) that I accepted that I could not incorporate scientific illustrations as the only art activities in the landform unit. For this reason, I was having serious problems trying to figure out how I was going to use visual arts to teach the earth science concepts like erosion, plate tectonics, and related processes. However, my struggles were soon the topic of my recess and afterschool conversational interviews with Annette.

The negotiation and co-planning that went into doing watercolor landscape paintings (a branch of visual arts quite different from scientific illustration) of Georgia landforms is a great example of how we were able to ‘co-plan’ to overcome my narrow view of what counts as

science and art in learning science. In the following audio journal excerpt, I reflect on the breakthrough co-planning session afterschool

We had a great planning session after school...activities the students could do to meet the state curriculum goals using four main activities in a circuit...we basically worked out what we were going to do for the science teaching. Then Annette asked what I was going to put up for the art show. And I mentioned that I felt a disconnection between the activities and the connections between art and science. So we wrestled with how the geology, the science, could be used so I could work with the students to create art products that would be appropriate for this art exhibition. We decided that our state landforms worked and how they formed – it's a good idea. Like Stone Mountain – that's a granite batholith. I think we're doing a better job of team teaching. And we did it! Now I know what to do for art and science. And it's good! (12/10/03, Audio Journal)

I was indeed excited about the connections made that day. However, a few days into the landscape watercolor activity at the Art and Science Table, my enthusiasm waned. In retrospect, it was my limited view of science that meant it was very difficult for me to stick to the plan and “talk science” (even though it was written on my hand – see case 2). For example, when the students wanted to choose a landscape very foreign to Georgia, I often put up only light resistance as the following interchange between me and a student shows:

Carrie: How about this one? (Pointing to painting of western plains, clearly not Georgia)

Jamie: You can do that. It doesn't look like Georgia. But you'll practice things like the rows here, grasslands. Let me show you a little about painting (I move into a demonstration of watercolor).

The following excerpt shows how I get off track, as I illustrate landforms on the chalkboard to the whole class. This event actually occurred on the same afternoon the watercolor landscape activity coalesced (see above conversation interview with Annette).

Roy: I made my mountains, I didn't make them icy, I made them green.

Jamie: (interrupts Roy, asks whole group) Where are all these landforms suppose to be?

Two Students call out 'Georgia.'

Jamie: all of these landforms are suppose to be in Georgia. And so this (points to icy, sharp-toped mountain), it looks like Mt. Everest. A really tall mountain. Is that in Georgia? Is Mt. Everest in Georgia?

Many Students call out "no."

Jamie: No way. So actually Roy is more realistic about drawing Georgia Mountains than these real sharp mountains. But I think these look prettier so I'll draw 'em this way.

Having the students paint from pictures of Georgia was so critical to the lesson because the students had personal experiences with those landforms – connections Annette and I could draw upon in teaching the science concepts..For example, although it is no surprise that Roy (above) picked Mt Fuji (a snowcapped, volcanic mountain – see figures 4.6 and 4.10) for his painting, he had no first hand experiences with that particular landform/scape. It made it harder for Annette, myself, or his classmates to relate the science concepts to his personal experiences. This was apparent in the writing most of the students did about their paintings which were displayed along with their biographies in the exhibit. If we could not relate the science concepts to the paintings, the integration between art and science was lost.

Later that month, I drew in our dialog journal my idea of how labeled diagrams could point out the science in the paintings.



Figure 5.6. My labeled diagrams of mountains eroding and sediment deposition. Faults are included to the right.

I gave examples with science concepts and it seemed so simple. All the kids had to do was diagram abstract concepts of faults, erosion/deposition, plate tectonics and other factors related to their landscape painting. Of course, as I wrote in that same entry:

I have been a little worried that my table art lesson has been too much art and not enough science. It always seems like I can barely keep up with all the art techniques and

I forget to ask them about their ideas and experiences related to landforms and how they were created. (12/19/04, Dialog Journal)

Indeed, I was so busy with art techniques that I forgot science...especially since what I meant by 'science' was difficult to explain without spending all my time and energy doing diagrams like the one above.

The following excerpts from students' writings illustrate how they perceived my work with them. All of the sentences they wrote addressing the science requirement *describe the science behind your painting* were included.

My art teacher Jamie taught me how to paint. He also taught me how to draw landforms. My other teacher [Annette] taught me how erosion works. Jamie helps me put in things that I want in my picture. And he taught me how landforms move. (Danny. from his Artist bio about his painting of Georgia coastal dunes from photograph, 1/2004)

Mr. Jamie taught me art. My picture is a landform. It has oceans and forests. I made it with water paint with the help of Mr. Jamie. I think my picture is good and I like it. The landforms are forest, ocean, mountain, valley, volcano, river, canyon, lots of things. They hurt people sometimes and like mountains, things are made with weather and water. (Hui Jung, from his Artist bio about his painting of New Brunswick, Canada copied from painting by Martha Odum; 1/2004).

The person that helps me with art is Mr. Jamie. [He] helped me with lots of stuff like drawing straight lines and 'don't' look at your picture, look at what you're drawing.'

Mrs. Santana helped me with science like how to do experiments and work better. ... My landforms show science because they are half of our globe and world. My painting about landforms is important because if we didn't have them we wouldn't have salt or sand or

rocks or jewelry. (Dominic, from his Artist bio about his painting of Georgia reservoir from photo, 1/2004)

Mrs. Santana and Mr. Jamie help me with my art and science. They teach me everything I need to know. Ms. Santana teaches me science so Mr. Jamie can teach me art...The science it's very worth while because once I learn the science, I can do the art. (Jackie, from his Artist bio about her painting of Georgia coastal cypress swamp from photo.1/2004)

I enjoy art because Mr. Jamie Calkin helped me with it in science. I drew my picture with water paints. My picture is pretty to me. I made my picture by imagining my idea in my head. I have a lot of hills and valleys in my picture. They are important to me because I drew it myself. (Allen, from his Artist bio about his painting of cloud formations over Western U.S. Plains copied from *The Big Book of Painting Nature in Watercolor*, 1/2004)

The important and consistent ideas from the excerpts above (which were consistent in subject and style with the other students' writings) are: 1) the science concepts included were trivial connections at best, and 2) most students viewed me as the art teacher and Annette as the science teacher. Most important to this template is how limited in content the writing was on science concepts. My experience in talking with the students was that they were not able to share much more orally. In other words, much of the science they were exposed to during Annette's whole group instruction was not successfully connected to their landscape paintings created at the art/science table with me.

Template two: A question of epistemological fit: Jamie Dewey co-teaches in Annette Vygotsky's classroom.

Introduction to Template Two

I ask some telling questions to introduce this template. Why did Annette and I approach the unit planning so differently? And why were the resulting plans so different?

In this section, I answer the questions above by framing my answers in terms of a question of epistemological fit. Once again, I constructed this template based on an analysis of the root causes of perceived failures in my teaching. I constructed template one based on our respective views of 'what counts as science' to explain my perceived teaching failures. In a parallel way, template two was constructed by looking at my perceived weaknesses in planning compared to what I perceived as strengths in Annette's ability to develop curricula (in our study, unit and lesson plans).

As the title of template two implies, my epistemological beliefs parallel those of John Dewey while Annette's are aligned much more closely to those of L.S. Vygotsky. Table 5.1 previews the different claims and comparisons I make between Annette (Vygotsky) and myself (Dewey).

In Table 5.1, I compare the main differences between Annette and I based on Vygotsky vs. Dewey as they will be discussed. I start with our respective views of science learning, next denoting the main fit we view visual arts has in teaching science. Next is the different ways we plan our instruction, including the ways we dealt with envisioned high stakes testing impacting our plans. The last sections of the chart hint at the ways we enacted our instruction. These differences provide the transition between the first two templates (about our differences) and

template three (about seeking/finding balance between our differences as we sought to co-teach the best ways we could). But now, however, I turn to our respective epistemologies, specifically in the context of using the visual arts to teach science.

Table 5.1. The main points comparing “Annette Vygotsky” with “Jamie Dewey.”

Epistemology	Jamie – whose notions of teaching/learning more in line with those of John Dewey	Annette – whose notions of teaching/learning more in line with those of L.S. Vygotsky
Science learning theory	Aesthetic understanding (Girod & Wong, 2001)	Discourse-based approach (Lemke, as cited in Girod & Wong, 2001)
Likely ‘fit,’ justification for using visual arts	Dewey’s (1934) art experiences, Franck’s Zen of Seeing (1973).	Visual arts as a tool to communicate; tool for learning, like language – Gallas (1994), Ernst (1994)
Key ideas	Activities, experiences (aesthetic), interest, possibilities, transformation, emotions/feelings	Activities, Tools, mentoring, zpd, science talk/discourse, texts and language
Teacher’s role	Facilitator	Mentor
Directional tendency – plan and view students’ activities vs. intended learning objectives	Bottom-up – inspired by QCC’s (mandated curriculum), instigate/facilitate authentic activities ; facilitate students in doing own activities that lead to <i>experiences</i> ; that lead to unintended and intended consequences.	Top-down – analyze QCC’s (mandated curriculum) in order to prioritize and sequence age-appropriate learning goals (tools they should know how to use: concepts and processes), determine assessments, then sequence instructional activities
After starting with the ‘QCC’ what’s next question in planning	“What activities would interest me that are possible, what about the kids?”	“What do the kids really need to know, what are the tools that are most important?”
Epistemology related to ‘accountability’ and standardized testing	Dewey’s bottom-up approach almost completely at odds with high stakes tests (any ‘mandated curriculum’); these realities force teachers to plan top-down, to separated learning consequences from processes (to plan/teach for intended consequences is at odds with teaching for ‘experiences’ – where the process of learning is inextricably linked to the consequences of learning)	Within climate of high-stakes testing and teacher accountability to mandated-curriculum, some room for discourse methods and teaching the tools which are on the test. Still tensions because tests ‘cover’ so many of the terms/vocabulary without assessing deeper conceptual understanding or processes/tools.
When things are going wrong	“uh-oh, better try the next activity, they could be bored with this one”	“Hold everything. We’re not getting it, we need to slow down and ‘get it.’”
Appropriate setting – ‘ultimate choice’	Playground or museum trip – where students have ‘ultimate’ choice	Classroom – where teacher has ‘ultimate’ choice

Our respective views of science learning and using art to teach science

I was able to situate Annette and my own respective ideals of teaching and learning firmly into the arena of science education after reading an article by Girod and Wong (2002), in which three broad approaches to teaching science are described in relation to each other based on their respective perspectives on science learning: 1) conceptual understanding via conceptual change theory, 2) discourse-based understanding, and 3) aesthetic understanding. Annette fell neatly within the ‘discourse based approach’ to teaching science while I aligned myself with teaching science for aesthetic understanding. I reiterate that these approaches reflected our ideal beliefs about learning science. As described in template one above, my deep seeded views of what counted as science certainly affected how I thought about science teaching and learning. In fact, those views demonstrated in template one meant I fit more in the conceptual understanding (via change), Girod’s third model. Before discussing the resulting tension between my own opposing beliefs (in template three below), I compare Annette’s and my own ideal approaches as they were evident in our words and actions.

Jamie’s teaching science for aesthetic understanding

To illustrate my ideals and implicit beliefs about teaching science (for aesthetic understanding), I refer to an audio journal entry done just after my scientific illustration course:

....what I want to do with the students is help them have the kinds of learning experiences I’ve seen us having in scientific illustration this semester. For example, when we were really studying a bone or specimen by drawing it. But more than that, getting lost in the process. I’ve talked to a few in my class about it, how it’s a bit embarrassing but how much we can really get into drawing a dead insect or tree branch. But we’ve all

felt it, that excitement when we're really looking and the pencil just seems to be doing everything on its own. When even time changes. (10/17/2003, audio journal excerpt).

Teaching for aesthetic understanding is modeled on Dewey's notion of art experiences (or *an* experience). I allude to those experiences my classmates and I shared during our hours sketching natural objects. Girod and Wong (2001) note that art (or as they term) aesthetic experiences tend to have three qualities; they are compelling/dramatic, transformative, and unifying. In the excerpt above, I noted how in my conversations with my classmates, we were a little embarrassed about the fact that we could get so excited about the process, something one classmate shared her roommates did not understand. How could a bone or leaf be so dramatic or compelling?

In the next audio journal excerpt from early in the study, I share *an experience* I had which exemplifies the transformative and unifying qualities Girod and Wong wrote about...

While drawing a trillium flower on a trail a few years back, I started seeing that it was not just the flower petals, but other things about the plant that came 'in threes,' – the leaves, other structures within the flower. I had only just begun taking drawing and painting classes again as an adult. And I remember this was one of the first times I stopped worrying about what my drawing would look like or how terrible it seemed. No, I really got lost in it, time moved slower. I remember thinking afterwards; this was even a different way to be outside, to be out in nature. It seemed more intense, the bird songs, the sunlight and shadows, everything. (5/03 audio journal excerpt).

The description of heightened perception illustrates both the unifying and transformative qualities Girod and Wong described in art or aesthetic experiences. Specifically, I had been backpacking for a number of years; even so, my time drawing that flower left me feeling

differently, feeling like I had really done something new. Furthermore, I had a heightened sense of perception and found similarities between the intensity of not just perceptions resulting from sight/vision – hearing the sounds of the birds that integrated into that experience, a reflection Franck (1973) alludes to often in his book *The Zen of Seeing*. It was all of those features from my own positive experiences with art and science that I wanted for the fifth graders. I turn now to Annette's approach and the outcomes she wanted for her students.

Annette's teaching (the tools and culture of) science with a discourse-based approach

Annette ascribed to an approach much more aligned with discourse-based science learning; the central claim of which was that students talking and writing about science is essentially equivalent to learning science (Girod & Wong, 2001). In sharing her own beliefs about teaching science, the following excerpt was part of a telling conversation after school one day early in our collaboration:

I think the ways I look at science teaching are also influenced by what I've learned about teaching language arts, and from teaching language arts. If kids are talking or writing about science...really doing it without a teacher standing over their shoulder, but on their own or in small groups...that's half the battle right there (6/3/03, conversational interview).

The above claim fits with Vygotsky's emphasis on language central to learning. This was the subject of Annette's own work in graduate school so it is no surprise that it would impact her science instruction. It is interesting in that her comments came after she discussed her love of the subject of science and how she views inquiry or 'experiments' as a big part of her teaching

(discussed above in template one). I watched her integrate those things many times in her work with the students, talking/writing about science and doing ‘experiments’ in science.

Annette’s view of visual arts as another tool for expression (see template one) echoes the discourse-based approaches espoused by two other elementary teacher-researchers, Karen Gallas (1991, 1994 & 1995) and Karen Ernst (1994 & 1997). In the same way Annette viewed the importance of drawing and painting, Gallas and Ernst view art as tool and even another form of ‘text’ or discourse.

In discussing the meal conversation metaphor (representing our co-teaching), Annette again relates talking about science as crucial to learning it.

A: *Some of them did a good job of getting the information and rephrasing it and you know, presenting the information. I think when they did their little adaptation charts 5 or 6 of them really figured out what we were talking about. Their specific animal – Here’s what my animal can do and what I know about them. So, I think it’s not an excited kind of meal time. It’s a pretty mute, um, not mute but kind of quiet, calm place to be as far as around the table. But at the same time I do think they do have something to bring to the conversation. Not all of them but a lot of them.* Post-unit 2 interview (11/25/03)

While Annette spoke of ‘conversations’ metaphorically (above), she referred directly to other discourse-based terms. For example, ‘rephrasing’, ‘presenting the information,’ and ‘what we were talking about’ all reflect talking and/or writing. It would follow that Annette would see the connections between language arts and science.

Indeed, Annette mentioned integrating writing time with our science and art units often, as in the following excerpt from a conversational interview during recess in between units two and three.

Annette: We can use writing time, the hour before lunch, to teach that concept too. I've had them draw pictures as a start to writing assignments before. Do you want to demonstrate a science drawing and we can help them do their own, then during writing time, they can write about their drawings in their science notebooks, maybe telling a creative story but including some of the science ideas in their drawings too.

Jamie: Oh, okay...

Annette: But I don't mean to tell you how to integrate the art thing. I've just done it that way before. But you're the expert on that. (12/8/2003, conversational interview).

In the excerpt above, Annette reminded me that writing time could be used to teach science as well. Our beliefs about our ideal approaches were not made explicit during my time in Annette's classroom. However, intuitively I knew this was consistent with her overall approach to discourse-based teaching. As she did on other occasions, Annette added an important epilogue to her feedback, confessing to having little expertise in using the arts to teach science (this will be discussed in detail in template 3).

What inspires students to learn/do science also plays a role in Annette's approach. Girod and Wong (2001) note that one of the primary motivations for students taught in discourse-based settings is participation in groups, something acknowledged by Annette above. The follow image illustrates these points as Annette uses science materials and emphasizes science discourses in motivating the students.



Figure 5.7. The students are talking science in small groups.

Notice in the digital photo above that the students behind Annette are working in small groups, clearly motivated to engage in and talk about the science activity. In the foreground, Annette is mentoring students in another group, illustrating another feature of discourse-based teaching.

Our perceived roles: teacher as mentor or teacher as facilitator

The role the teacher takes, whether they view themselves as mentor (Vygotsky) or more as facilitator (Dewey) illustrates another difference between the two approaches. As Figure 5.7 above shows, Annette is taking a very active role in demonstrating the science discourse and processes as she guides the students to create ‘mountains’ with the sand. In the contrasting image below (Figure 5.8) I take on the role of facilitator as I work with students in creating landscape paintings using watercolors.



Figure 5.8. I paint with the students at the ‘art and science’ table, taking on a role of ‘participant-facilitator.’

The digital photo above portrays a role I sought whenever possible. I wanted to instigate activities, and, by being primarily a participant myself, keep the activities going – thus playing the role of a facilitator. Ideally, I wanted the students to learn and create ‘science paintings’ on their own, thus increasing the chance for art experiences. Dewey claimed that students had experiences when they answered their own questions in ways they developed, without too much intervention from ‘mentors.’ Conversely, Annette viewed herself primarily doing just that...mentoring students. In the following excerpt from a conversational interview afterschool, Annette uses her own beliefs about teachers’ roles to point to a dilemma of being a ‘participant-facilitator.’

Jamie: I really want them to do it all, for the students to do their own drawings and use their own ideas; I can just do my thing with them.

Annette: But isn't your role to show them some of the techniques, if not telling them how to do it, but even better, by modeling the art by doing it in front of them. And bring up science ideas when you can.

Jamie: Yeah...but often I get so excited, I can't seem to stop telling them what to do and how to do it. Even telling them what science they should see in the work, when I remember I'm teaching science.

Annette: I don't know, from what I've seen when I get a chance to listen in, you've done well balancing mentoring with letting them do it on their own.

Jamie: Good. I guess I just worry I take over too much. I get so excited.
(12/17/2003, conversational interview).

In the next excerpt, Annette describes some of the issues of discourse methods of learning science, relating why it is important to have self-motivated learners and how she perceives her role in that process.

Annette: ...When we do reading groups, I like to split my kids up and know that they're reading and talking about their books. What I want to see in everything that we do is a deeper delving into what's going on—the why behind the what. You know, 'Here's what we're doing and why are we doing it?', and 'What does it mean and how can I take this a step further?' Especially related to reading—applying critical thinking to what we're doing. You can do that with anything, you know, what you're reading about in science, what you're reading about in math. So this says to me that it's possible to do that in small groups, letting the kids work on their own sometimes to see how far they can go, probably some kids more than others. (11/25/03, conversational interview).

In this excerpt there is a real emphasis on learning by using different discourses (reading, writing, talking). Specifically, Annette denoted some pertinent questions she wanted students to ask of each other and themselves. She saw herself as a mentor in this, but also alluded to more of a facilitator role in that teachers sometimes need to step back and ‘see how far [the students] can go.’ Even so, Annette implies the main roles we had were as mentors in the excerpt below from the same conversation. In it, we are discussing the ‘dinner table metaphor (case 4).

A: *...I think we brought the main ingredients for the meal or whatever and the kids bring some of the extras. What else do they want? What else are they interested in? You know, the conversation over the dinner table is going to range from, you know, that’s a funny thing to show on a video to I want to go outside and play to here’s what I’m doing with my report.*

We brought the main ingredients for the meal – the main learning goals and activities. Students apply it in specific ways. This is Vygotskian. It is discourse based too, especially because there is no mention of changing misconceptions, just talking about science. “The conversation at the dinner table” metaphor seems like one of the real constraints with Dewey’s bottom-up model. Annette explains that when kids are not interested, it is very difficult to initiate instruction around ‘their’ activities. This makes me think about classes like yearbook and newspaper – those are the courses I could succeed in teaching.

Our different approaches to teaching science meant that we took on the task of planning the science units in very different ways. As will be discussed next, my intentions for the students proved difficult to plan. Having aesthetic experiences cannot be forced onto kids. In some similar ways, science talk, one of Annette’s core goals, could not be ‘imposed,’ but had to come from authentic and spontaneous questions and responses posed by the students themselves.

Thereby, she had some of the same difficulties in planning; however, for the most part, her preparation techniques proved much more consistent with her goals for providing chances for the students to talk science (compared with my intuitive goals for the ‘having of art experiences’).

Activities - planned

In this section on planning, I first summarize the main points of how planning factored into our respective ideal approaches before providing and discussing data excerpts that related to each of the points.

My bottom-up approach was quite different from Annette’s top-down planning scheme. The way Glassman compared Dewey and Vygotsky provides a way of looking at the ways Annette and I planned our units. I did the following: 1) skim the state curriculum goals, 2) brainstorm ideas for activities related to my own and the students’ interests as well as the curriculum goals, 3) brainstorm and start stuff-to-do lists to gather resources and materials deemed necessary for the activities, and 4) sometimes develop assessments (mostly project rubrics) and revisit art objectives, sometimes not.

On the other hand, Annette’s top-down approach meant a different sequence of planning: 1) scrutinize the QCC’s, deciding which are most important and which can just be covered briefly, 2) sequence the concepts and processes to be learned in a logical order that reflect her notions of the best science culture possible in the classroom, 3) determine assessments that will allow her to evaluate whether the students learned the most important concepts, and 4) finally sequence doable activities often centered on inquiry as well as writing about science.

In applying this template to texts/data, it proved helpful to create (and revise many times!) a flow chart that emulated the steps Annette and I took in planning. In the diagram (below), I also sought to reflect our respective epistemologies, that is, our views on how teaching

and learning occurs. To do so, I used Glassman's (2001) three fundamental aspects of education: 1) social history and tools (in our case, science), 2) culture/experience, and 3) students' activities (or human inquiry). In addition, I tried to represent the oppositional ways Glassman claimed Vygotsky and Dewey viewed each aspect (and as the template dictates, ways I believed Annette and I differed). Among the most important features of the diagram is the direction of the arrows on each side of the dotted line that separates *Jamie Dewey* from *Annette Vygotsky*.

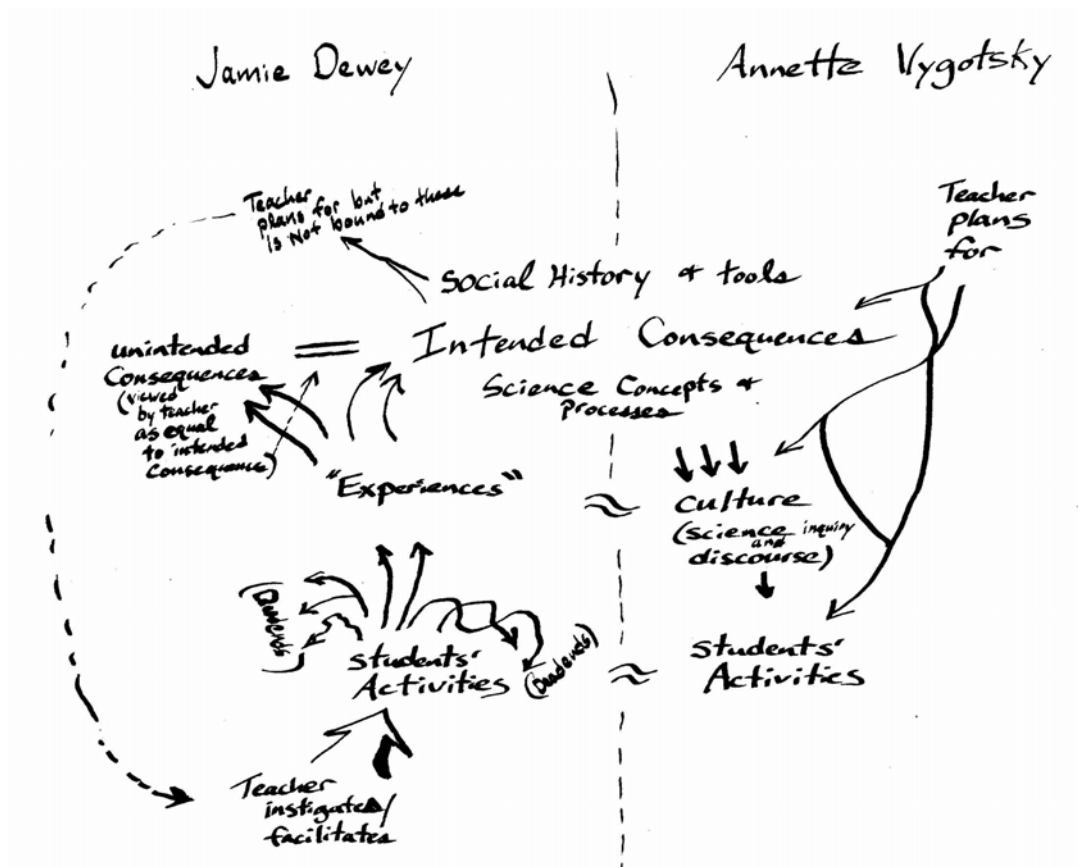


Figure 5.9. Glassman's categories of education to contrast Dewey vs. Vygotsky. My own bottom-up approach and Annette's top-down notions are contrasted as well.

Dewey (and my ideal approach) start with student activities and lead up to 'experiences' that contribute to intended and potentially equally valuable unintended consequences.

Conversely, Vygotsky (and Annette's ideal approach) starts with very intentional consequences

of learning, which determine the classroom science learning culture, and finally a sequencing of appropriate activities the students are to be mentored in by their teacher (or more capable peers). Since we went in different directions, it's difficult to sequence my discussion of the opposing ways we (and Dewey/Vygotsky) viewed each aspect. Furthermore, as Glassman (2001) noted (and claimed both Dewey and Vygotsky would agree), to separate the aspects is artificial in that each is not separate in reality. Even so, I compare and contrast each as best as I can below.

As different as I claim our ideal approaches to be, Annette and I both started our planning with the state curricular goals, the QCC's. I thought all teachers started with learning objectives in planning their instruction? Whatever the state or district curriculum was...it was only after reading Glassman's (2001) article that I realized that I was immediately adjusting my intuitive Deweyian notions to what I thought was expected of all public school teachers. The following entry in my research journal illustrates this tension:

I did not question the potential problems of starting out with the QCC's (the state science objectives) at the time, of separating the consequences of learning from the processes, something Glassman notes Dewey vehemently argues against. I guess I was just used to that, starting there; I'd been teaching long enough so it was habit. (10/30/04, research journal).

In fact, the very presence of state mandated curricula (that includes so many specific learning objectives) is a constraint on teaching for aesthetic understanding. What it leads to is that the best the teacher can do is: 1) inspire kids to do real-world activities by placing them in environments/situations where they are likely to achieve the same goals as external curriculum, and 2) hoping they actually have experiences that lead to those intended goals because free

inquiry (not guided inquiry) is the ultimate goal; in other words students' activities should fit with their own interests.

Returning to what actually happened. Annette and I both started in the same place when we sat down to plan the science units...with the QCC's. However, I did it because I thought I had to. Even so, I still found ways to return to the bottom-up approach. For example, after briefly scanning the state objectives, I thought about possibilities for art experiences that fit with the science ideas (the QCC's)...a process consistent with what Dewey (according to Glassman, 2001) and Girod and Wong (2001) identified as goals for students. The problem of course is I (the teacher) was the one listing all the things that were possible...all the activities and experiences the students could engage in and experience firsthand.

In the next example, I cut and paste my actual 'unit plan' for unit three. After pasting the state objectives on the top of the document (not shown), I had typed up as I brainstormed, all the ways I could think of where we could use visual arts in relation to the QCC's.

Here are some things I've thought about:

- *Starting with the ocean water salt experiments as an example of 'deposition.'*
Drawing the crystalline forms using magnifying glasses.
- *Do landscape drawings/paintings comparing the Rocky Mountains with the Appalachians – comparing emerging mountains with eroding mountains.*
- *Erosion and deposition in the school yard. In the construction site of the new school (or is that too far away).*
- *The aesthetics of maps*
- *Limestone and vinegar – like the QCC says.*
- *Freeze water in different containers.*

- *Plants and geology of schoolyard – make an illustrated book.*
- *Dams and river ecosystems, endangered species – age of ecosystems (w/o ‘recent’ ice age here in Georgia).*
- *Drawing different types of volcanoes – done last year.*
- *Draw abstract concepts like erosion and deposition of rocks, faults and plate tectonics. Use as assessment tool also.*
- *Geology club on campus? Rock and mineral samples?*
- *Clay sculptures out in rain – see em disintegrate. Discussion of how we get clay.*

(11/23/03, from Jamie’s ‘Geology Unit Plan’)

This list was my initial ‘unit plan.’ I shared it with Annette during a conversational interview. At that time, I wished desperately that I had more (something like my ‘big picture’ Annette referred to above). However, this was all I had (not aware at the time that this, another one of my crazy lists of fun activities, was more consistent with my approach than that of a ‘big picture plan’. The excerpt occurred after I apologized for not having a better plan when Annette looked up after quietly reading over the whole list.

A: ... in the first one...

J: Yeah, right. The salt water experiment

A: yeah, now when I look at this I think we stopped with the ocean so we start with the ocean. We talk about, we talked about at the very beginning about the different things we found under the ocean, all those different kinds of landforms, so you start there and then you bring it out too – you find these on earth too. You talk about the faults, you talk about the ring of fire, you talk about plate tectonics and that’s when I do my brownie

thing and then you come out and start looking more closely at specific issues like erosion, deposition, and weathering, and those types of things and it's pretty easy.

J: I think it's a great link too. And it doesn't have to be at the beginning – those ice crystals. That's how like chemical sedimentary rock, is exactly that.

A: Yeah, and you can teach about that because I don't know. To me that's definitely some sort of, you know you talk about stalactites and stalagmites and how those things form. That's what I think of

J: yeah, yeah, that's it

A: so you go from there and talk about these things.

This is a really good example of Annette saying, 'Okay, here's the big concepts, here are the smaller concepts, and they fit together because...' She did that after looking at a list of random activities. At the time, I got 'distracted' with the possibility of linking the salt experiment to 'deposition,' only one of the many words she used. In preliminary analysis, my comment looked only like a distraction. Upon further analysis, I saw it as a kind of parallel conversation, one in which we are talking past each other.

Viewed on the basis of template two, I saw in the conversation above that I was doing what is natural for an educator interested in possibilities and starting with the child's activity. And even though I did not see it explicitly at the time, we both intuitively played on our strengths to co-plan and co-teach the science units, especially by unit three (this will be discussed further in the next template).

The next excerpt is from an unexpected but very telling conversation I had with Annette's husband, Jim (also a teacher). He highlights what he views as one of her strengths – her ability to lay things out in a sequential way, develop a plan and follow through.

Jim: Oh yeah, dude, Annette's awesome at this (as he looks at a list of the QCC's). Did you know she developed the curriculum for fourth grade science that got adapted by the whole county (since it was a very large school district, this meant hundreds of fourth grade classrooms/teachers).

Jamie: So every fourth grade used her plan?

Jim: Yup, she sequenced the whole year so that each unit built off the last one. They went from small to large. I think it ended with astronomy.

Jamie: Wow, she is good at planning.

Jim: I'm telling you, listen to what she says. (10/12/2004, personal conversation)

After listening again to this audiotape of my spontaneous conversation with Jim much later, I recorded the following entry into my research journal:

When I think about the nuts and bolts of curriculum development, of what Jim is talking about with Annette, what I saw her do so well...what a nightmare for me - methodically going through plans and proper wording – yuck!! Picking over details, good night, let someone else do that. I want to do fun stuff with the kids. (Dated 11/04, research memo).

While the above comments are clearly honest opinions about my approach to planning, what I did not realize at the time was that working out 'the nuts and bolts' was indeed, inconsistent with my belief that the best way to teach is by facilitating students' authentic inquiries, something Katz and Chard (1989) referred to as long-term projects (this will be discussed further in the implications, Chapter Six).

Annette determined the actual activities after the intended consequences were thoughtfully defined (see Figure 5.9 above, my adaptation of Glassman's top-down/bottom-up notions). We planned in opposite directions and when we met daily to co-plan, it was often in

‘different places’; not literally in terms of different physical locations. Instead, in our minds, we were coming at the same problem from very different directions (see the flow chart, Figure 5.9) In the next excerpt, I am asking her a very open-ended question (reflecting my desire to help her in the classroom anyway I can). What she narrows in on might be the one thing I had the most difficulty doing, the task that for her comes first but for me often comes last.

Jamie: Yeah, I guess, is there anything you can think of that ... um, I'll talk to you that half an hour before writing group and kind of during lunch and stuff during the next unit – about how to make it better for the next unit.

Annette: I mean, like I said before, bringing in all that extra stuff that is wonderful to have and that people don't usually have time to get that's really helpful. And, your whole idea for the unit plan in the beginning made it real easy for me to plan specific stuff because you had a big general picture of what we needed to cover and then I could just get really specific (laughs) or just stay really general. That was helpful too just as far as planning goes thinking about it that way. (11/3/2003 conversational interview)

We were preparing for unit three in the excerpt above. The truth of the matter is that I hated doing that unit plan; the one Annette refers to above. And worse yet, I only had that ‘big general picture’ after working closely with Annette. We looked at what went wrong in unit one and focused in on ocean animal adaptations. In fact, I listened to the many tapes of our conversational interviews, listing all the suggestions Annette said and things to change. However, note above that Annette gives me credit (your whole idea for the unit plan, and ‘you had a big general picture of what we needed to cover’). In reality, those ideas and big pictures

were much more Annette's than my own, and this is no surprise considering Annette's very intentional approach to learning consequences.

Annette describes her goals in ways that resonate with Vygotsky's notions of teaching students' relevant cultural tools. The following is an excerpt from our first dialog journal.

I often think about interest and need – what will kids need as adults – the abilities to read, write, do basic math, know general science and history facts and how to find out more detailed information. With these tools they can decide...I want to know more about... Annette's entry in Dialog journal 1 – 6/12/03

In the following interchange, we are discussing how our plans to use the school's new set of laptops are being disrupted by the requirement that all students pass a computer test before they can use the laptop.

J: so, your kids are gonna have to pass the test?

A: laughs – a little bit nuts. I think they'll figure out how to use them as you go along.

J: That's funny. I think that's an example of how you can maintain an island in a healthy way.

A: Definitely. Close the door.

Both of us agreed that students should learn to use tools such as laptops. We both felt that the students should be mentored in their proper use, and that the tool should be used for an authentic purpose. Annette noted 'they'll figure out how to use them as you go along,' in this case, as the students researched ocean animals using the internet and developed multimedia presentations on their animals.

Annette was adept at teaching students how to do things like that. In part, this was because of her experience and personal strengths. But related to the template, Annette was explicitly aware of what tools and concepts were to be learned and that she needed to plan instructional activities that facilitated the students' learning of those goals. On the other hand, I was more open to students exploring tools like laptops on their own, trusting that students would learn how to use tools naturally if those tools help them achieve their own goals and learn about their own interests.

Annette specifically kept a focus on the idea that the laptops were only a tool; in contrast, I diverged into talk more aligned with 'possibilities and experience.' Below is an excerpt from a conversational interview in which we were preparing for using the laptops (which did not become available during my time in Annette's room).

Jamie: An art teacher friend of mine was telling me about how kids loved to use the computer drawing programs. Maybe we could upload one onto all the laptops.

Annette: What did the kids love about it?

Jamie: Well, for example, erasing in watercolors is very difficult, but with the program, you can erase or change all kinds of things like color with a click of the mouse. My friend told me kids got into drawing that they otherwise wouldn't have.

Annette: Is it worth it? Like in terms of time and energy?

Jamie: I don't know, but if some of the kids really got into it, maybe...I'll look into it. (10/29/2003, conversational interview)

There was a very informal, friendly tone to our conversation that afternoon, not confrontational at all. Even so, the excerpt reflects our continued differences in ways of planning for learning. And again, it is only when I am well out of the field and viewing our interactions through a theoretical lens that I saw that Annette was probably thinking about how the drawing programs relate directly to teaching the intended learning consequences. On the other hand, I was thinking about possibilities for art experiences.

Annette's Vygotskian view fits much better with teaching curriculum than Dewey's, including high-stakes testing; even so, it is still a stretch, as Annette notes below.

Annette writes...I know I need to plan more related to all subjects to get some test prep in – I haven't done much. When I say test prep I really just mean getting the vocabulary out there – they'll see words like offspring, boundaries, stimulus – real specific terminology in all subjects and be lost. So when I plan I need to consider pulling in the 'QCC' vocabulary more. Blah blecky but true. (10/24/03, dialog journal).

The constraint of teaching to the test was ever-present, at least for Annette. But instead of making it all consuming, she discussed being more aware of it, just using more of the vocabulary. If it were all consuming, a teacher could spend all of their time just teaching vocabulary for example. She is addressing it as 'blah blecky' but a real factor ('but true'). Both the bottom-up and top-down models could address this constraint the way she described it, but it does fit better with discourse based ways of teaching science and learning.

Science terms signify a constraint with either approach if they are too many and too complicated. We did not discuss this issue explicitly or theoretically. Both of us just accepted that we needed to try to plan for teaching a lot of science vocabulary. However, Annette was much more adept at implementing vocabulary-based types of instruction. When asked in our

dialog journal to respond to the possibility that I was being insulated from the pressures of ‘accountability,’ Annette responded as follows:

Unfortunately, no one in the classroom can be truly be insulated from standardized tests. I know they affect what I do/plan in the sense that I use QCC’s, supposedly used to create test questions, to guide my direction and discussions. (10/21/03, Dialog Journal).

Annette relayed her belief that while the tests are not positively impacting our work, her own approach is not completely inconsistent with preparing the students to succeed on the tests. However, she lamented often about how many science terms and ‘trivia’ were on the tests, making it impossible to teach the way she wanted to ideally.

To summarize this second template, I rephrase its subtitle this way – my beliefs about the best ways to teach science were comparable with an epistemology that was different from my coteacher’s, in many of the ways Glassman (2001) contrasted the theories of John Dewy with L.S. Vygotsky. These differences played out in our interactions with each other and in the classroom co-teaching and inevitably created some of the tensions that explain our respective experiences.

Template Three: Finding balance between differences through collaborating

In this last schematic narrative template, I describe a process in which we found balance within our partnership in relation to two tensions: 1) epistemological fit (template two), and 2) Jamie’s competing teaching referents. In other words, underlying the stories I tell in this study is a framework by which two very different teachers formed a fruitful and dynamic collaboration to teach science using art. It is my firm belief that my work with Annette was productive not just in what we learned as teachers but in what we did as teachers. To explore this template (i.e. what undergirds the stories and texts that point to the productive nature our collaboration), I separate

my claims and evidence for those claims into two sections. Before turning to competing referents, I explore the ways my more ‘Deweyian’ ideas meshed with Annette’s more ‘Vygotskian’ notions in how we co-planned and co-taught the science units.

Finding balance and the question of epistemological fit

If it is indeed true that ‘Jamie Dewey’ co-taught with ‘Annette Vygotsky,’ in what ways did we find balance between those differences? In other words, if template two did represent our differing beliefs about the ideal approach to teaching/learning, there would have inevitably been some ramifications for our collaboration. For example, there was a tension (a push/pull) between the two distinct ways Annette and I initiated planning for instruction: scrutinizing the mandated curricular goals (Annette) vs. my own process of brainstorming to generate possible activities, glancing at the QCC’s for inspiration rather than direction. This example represents the larger ways in which Glassman (2001) described differences between Dewey and Vygotsky in envisioning how learning best occurred and the roles teachers should take in optimizing that learning. But as Glassman pointed out, no evidence exists to point to Dewey and Vygotsky working together. But if they had, in teaching say...fifth grade science, how might they have negotiated those differences? If not them, what about Annette and I?

Two possible explanations were viable constructions for analyzing how we found balance in the question of epistemological fit: 1) we respected each other’s strengths and actively sought ways to utilize them in our planning and instruction, and 2) we both found educative value in ‘drawing as seeing’ (Franck, 1973).

Appreciation for each other's strengths and differences as teachers

Annette claimed science requires different ways of teaching. In the following excerpt from our dialog journal, Annette addressed our differences as positive opportunities – specifically, the different ways we approach teaching and science actually fits with the nature of science. After noting that no two science teachers were the same, she wrote the following

Science is so interesting and ever changing that there can't be one way/thing to teach. Just ideas to pique curiosity and lead to the next question or discovery. For example, I have been thinking about that question from the article we discussed with the kids today...the 'animal that goes boom' that scientists are searching for – what can it be? I wonder. (11/18/03, dialog journal).

This statement points to that notion of possibilities and opportunities in our differing styles as teachers, especially as it fits with the way we both viewed science. While my natural tendency in working with kids was very much geared to 'piquing curiosity and discovery,' the constraints of the elementary classroom made that very difficult to plan for and implement with large groups (as I found out from unit one). Through our collaboration, we evolved ways to plan together by which I could retain those strengths but do so within an intentional plan for instruction and learning outcomes. In the next section, I discuss a related attribute of our collaboration where we implicitly sought to utilize our strengths.

Seeking to fit 'activities' (form $\leftrightarrow$ content) into a unit plan that started with intended consequences (content only)

In playing off each others' perceived gifts, we naturally enacted ways of planning/structuring instruction in ways that communicated a clear articulation of what we wanted the students to learn (Annette's intended consequences for the students) could come

‘first.’ Next, we negotiated and discussed ways the activities at the art and science table, where form and content were inseparable (Eisner, 2002), fit into her scheme. At the time, I thought she was simply better at all aspects of planning, but through the theoretical lens, I saw that her planning scheme was most appropriate for a Vygotskian discourse-based approach to teaching science within the constraints of the public school classroom. As will be seen in the next excerpt from an after school conversation, Annette guided me in fitting an activity I intuitively believed would be valuable into a rationale and direct connection to teaching the state curriculum goals.

The landscape watercolors activity (Georgia landforms) (see Case One, chapter 4 for more) was an example of how my idealistic, nebulous activity (more Deweyian meant to facilitate art experiences with science) was integrated into Annette’s more sequential plan. It was afterschool on the second day of Unit Three (I reflect on the same interaction in Template One above). Although I had intended and agreed to provide Annette with a ‘big picture’ idea of what I believed we should teach for that unit, I had to formalize it. Instead, we were teaching ‘day-to-day’ – something we both apologized to each other for doing. That afternoon, we had been discussing the day’s events and transitioned into our plans for the coming days. Annette had just shared that she was going to have the students diagram the earth’s layers in their science notebooks.

JAMIE: that’s good, see this is a whole different kind of art, drawing models that represent abstract ideas (pause)...So, I don’t really know what I want to do in the small groups [at the art and science table]

ANNETTE: well, what do you want to (Jamie interrupts)

JAMIE: One possibility is to look at landscape painting and drawing and trying to do foreground and background and depth in hills and... (Pause)...that's kind of a weak connection between art and science but...

ANNETTE: Well.

JAMIE: in theory I could talk about how mountains are made and how these mountains are...

ANNETTE: what do you want the art show to show

JAMIE: that's what I don't know, that's...yeah.

ANNETTE: if we're going to do that, what do you want to show...?

JAMIE: I think something collaborative would be nice, like something like that (points to mural in room on beach scene), you can probably tell I'm shifting gears, like this is not what I've been talking about, so I haven't really made the connection...what I've tried to do is start with the state curriculum goals and go from there, instead of starting with... (The art).

ANNETTE: because I would think you would want to have small pictures that could be framed and hung on the walls.

JAMIE: that's what I was thinking too

I am being ambiguous and indecisive about what I envisioned for the art show. For example, note my excuse that, having started with the state science objectives instead of the 'art activities,' I did not have a well formulated vision of what the students' products would look like. However, Annette begins to talk concretely about what the students should learn. It naturally emerges as showing the concepts by 'doing pictures.'

ANNETTE: even pictures that they could see demonstrating the way...demonstrating the earth, like the crust and how the things form. They could do a series showing change, like the brownies, which would show a whole lot of state curriculum goals, here we're showing erosion, we're showing mountains. And possibly show pictures of them doing it, I don't know, I don't have a good idea of what the art would be other than you showing how to do these kind of (geology) processes. It's different than the last unit (on ocean animals).

JAMIE: right, its hard, that's exactly right, and that's what my advisor wanted, was for me to be challenged by teaching art in something besides biology

Although I seem to be trying to distract us from the task at hand with my comment about an unrelated tension, there was no diverting Annette – for she had started to help me think about the intended learning consequences, and talking about the theoretical differences between teaching biology and earth science using art was not to sidetrack her attention. She continues...

ANNETTE: for me, when I was working in my first district, being to able to see the change of, 'here's my mountain of sand that formed this way, and here's the water coming down onto it and it turning flatter and the part where it would get washed down on the bottom. Seeing what that looks like and seeing them demonstrate that is what I'd have the kids do, and they'd have to show how the river forms and what the coast would like look. And they would do those kinds of pictures

JAMIE: That's great for the art show...

ANNETTE: Right

JAMIE: it's different than my initial idea of what an art show is...But if we changed what we were saying to the kids about 'this is demonstrating you're learning.' Instead of 'this is an art...

ANNETTE: (interrupts) I mean, they'd still have to do...

JAMIE: yeah, oh, yeah, it could be aesthetically, very nice looking.

ANNETTE: and you could do landforms, I mean, we're talking about it, and they can pick a different landform they want to work on and they can talk about it more. I don't think they could do something that showed all these processes interacting. I think they could pick one thing and try it. Laughs

JAMIE: yeah and I could show...

ANNETTE: like Ketondra did last year, remember when you gave out those pictures last year

JAMIE: oh yeah, the volcanoes

ANNETTE: and they tried to draw them and put them on the map

JAMIE: right, so like famous landforms, famous valleys, and famous mountains.

ANNETTE: and maybe this year do Georgia ones, like that gorge...

JAMIE: like Stone Mountain...

ANNETTE: like Tallulah Gorge

JAMIE: oh yeah. Oh! I think we're on to something here.

I recognized this activity as a valuable connection between drawing/painting and learning about landforms and earth science...and with great relief and excitement. Annette had articulated concrete connections between something we needed to do for the coming art show and the landforms within our state, making it even more relevant to the kids experiences.

Furthermore, I had already envisioned that activity as something I could facilitate at the art and science table (I just could not envision how it was directly related). We excitedly continued (notice my ‘oh yeahs’ – almost equivalent to ‘AMENS’ at a religious revival)...

ANNETTE: like the Georgia coast.

JAMIE: yeah.

ANNETTE: and like the swamp, it’s beautiful down there.

JAMIE: oh yeah, art...

ANNETTE: so we could use pictures of stuff in Georgia and they will pick one that they want to try, you know, different types of trees down there (on the coastal plain)

JAMIE: yeah, and I could show them how to draw the trees down there, and the coasts,

ANNETTE: and we could probably find a tourism video on Georgia, like one that’s got all the different places.

JAMIE: oh yeah.

ANNETTE: like a tourism video, and we could watch that

JAMIE: oh yeah.

ANNETTE: and we could finish in January. (She extends the science unit even though she had planned to move to social studies).

(12/10/03, Conversational interview)

What occurred above was the type of co-planning we engaged in by the end of the study. It was much different from the type at the beginning, where Annette helped me with the logistics of planning, but I made most of the decisions about which activities would be done when. Annette’s guidance with integrating the art activity into a bigger overall scheme was something that by our third unit together, I welcomed. I was most excited because the science connections

to the art activity were real; something the following interaction helped me realize was not necessarily easy.

Just two days earlier, I was looking at a book I had just ordered for the unit (Art in the Parks). Three students (who had finished their work before lunch) were milling around the art and science table where I was sitting.

Student 1: is that in Georgia?

Jamie: No, you see how big the mountains are? Our mountains don't look like that in our state.

Student 2: What do you mean?

Jamie: well, see how sharp the edges are on top, how there's not trees. These mountains are still relatively young still forming.

Student 1: So?

Jamie: well, let me see if I can find a painting of the Appalachian mountains...here, this is in Tennessee but its close.

Student 3: what's the difference?

Jamie: see how rounded they are, how the trees go all the way to the top. Over millions of years, erosion has rounded the rock tops, and there's soil enough for the trees to grow. (I look up to empty looks). Any of you ever been out west, seen the Rocky Mountains, these mountains (I page back to the first painting and one new painting also of the Rockies).

Empty looks again.

I shared my conversation with Annette that afternoon, and she was not surprised. "I bet a lot of them have never been out of the state," she said. But after we talked about the Georgia

landscape paintings, I figured I would be able to make a lot of connections not just to their own personal experiences, but also to the science concepts.

However, students still managed to pick scenes, often again my nudging, that did not resemble landforms in our state and were therefore outside the realm of their experiences. After working with five groups of students, I myself had forgotten about the original conversation (remember the clear ‘intended learning consequences’ that I agreed to) with Annette about Georgia landscapes. In my last session with students before the art show, I had encouraged Tarek, pictured below, to work from a desert/Rocky Mountain scene.



Figure 5.10. A series of photographs of Tarek painting Death Valley, California scene (original painting he worked from by R. F. Woelfer, titled View of Black Mountains from Badwater, (Wolf, 2000)

The scene had no resemblance to the geology of our region; what attracted both Tarek and I to it was the contrasting tones, strong forms, and crisp colors. This divergence from the original plan was the result of my tendency to ‘go with the flow’ – the students and I were

very interested in the painting techniques and less so with the science talk (at least the talk I tried to instigate, I will return to this again).

Tarek wrote about the final piece and his feelings on art and science.

My picture is a landform picture. It has hills, trees and a big fence. The trees were dark green and the ground was kind of orange color and mixed with some green to make it look cool.

Learning science is fun when you know what you are doing. I made my landform picture because it looks tight [cool] to draw something you've never seen or drawn before.

The emphasis in his paragraphs is on the colors and how the landform looks, although he begins his answer to the required question, "What science ideas about landforms are in your painting?" The intended goal of geological 'processes interacting' got lost in the activity. At the same time, Tarek had a very positive experience in painting and then showing his work, perhaps because I did not overburden him with abstract earth science processes. This tension became increasingly clear as the study progressed in part with the shift to the more difficult geological concepts but also because of our dialog about the teaching. Annette's ability to help integrate my activities into her larger classroom structure was undeniably linked to her ability to manage a classroom that had many different working parts. The 'working part' that became mine was most often what came to be called the 'art and science table.'

The art and science table

By creating a space for me at the 'art and science table,' we could coexist in ways that allowed us to teach very differently in striving to fulfill our respective epistemological ideals. While working with the majority of the students, Annette could plan and teach for intended learning consequences. At the same time, I could work with a smaller group of students in

creative and artistic ways that were more open to unintended yet positive experiences (with science ideas and art materials). The art and science table provided a space for students to be with me in an environment more suited to my strengths, like my intense but non-judgmental feedback and excitement in helping kids do what they wanted to do. At the same time, Annette could be engaging the rest of the students in science talk with a focus on intended consequences – much more aligned with her strengths (facilitating discussions and juggling the many tasks of classroom management). Figure 5.11 below illustrates this coexisting yet divergent instruction.

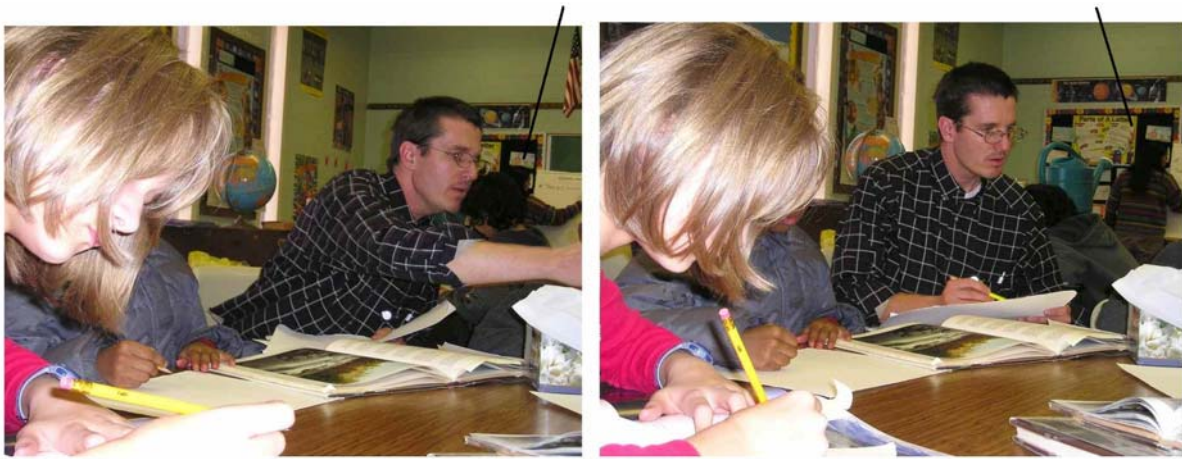


Figure 5.11. Annette is in the background writing on the flipchart (see lines) while, in the foreground, I work on my own drawing after I had gotten my handful of students started on their own in preparation for painting their watercolor landscapes at the art and science table.

At the art and science table, I could take on the role of instigator/participant (a type of facilitator). My insistence on kids *doing* activities was attainable there. I found I could have the fifth graders working with (handling, manipulating, creating with) the art and science materials without too much forethought about the correct way (that is, on intended consequences). While this might have made Dewey proud, it was also extremely difficult to implement/manage with a large group.

Drawing as a way of seeing fits with both approaches

Annette appreciated that drawing what you see is an important tool for learning and expression (Gallas, 1994). While Franck (1973) emphasized the experience (i.e. the process, like Dewey's bottom-up, free inquiry), the products/consequences of his approach fit within Vygotsky's top-down teaching.

Landscape paintings find their way into Annette's discourse-based approach.

After school one day, Annette reflected on how the kids were finding connections during her school yard geology walk.

Annette: I can't remember who said what yesterday, but a number of the kids noticed that the hills in the distance were grayer and much smaller than the greener hills closer to us. I mean, they got the idea that the distant hills may have been larger in size but they still appeared smaller. And we talked about how the foot hills of the Appalachians. They were really in to it. (12/11/03, conversational interview).

The excitement and emotional aspects of Annette's description of that science talk also provides evidence that the students had *art experiences*. Girod (2001) notes that when students see their worlds in new ways, like being excited about seeing the hills in new ways, they are pointing to two of the attributes of having aesthetic understanding; that is, it is transformative and dramatic.

Furthermore, Annette found the students' comments to be evidence of the value of landscape painting as a tool of observation. Her interactions during the geology walk also offered her a chance to relate mountain formation and deposition in a brief science talk (Gallas, 1995) with the larger group.

The students' drawing of marine animals is discussed in Chapter Four and earlier in this chapter. However, I reiterate the claim that Annette and I both viewed these activities and conversations that ensued during and after them as consistent with our respective teaching ideals.

How our collaboration helped us teach through Jamie's competing referents

If I believed science was the work of scientists alone, how could I then claim that facilitating anyone (much less 10 year-olds) to explore the natural world around them using drawing and painting could count as good science teaching? While these competing referents made it impossible for me to view my own science teaching as successful, I was not consciously aware of them during the study. Therefore, we made no special efforts to resolve them through the collaboration. However, what did occur through the collaboration was that I was able to often feel partially successful in teaching science (using art). In addition, the experiences and events, when seen through my theoretical lens in later analysis, allowed me to find that Annette had often steered my work in positive ways. Besides the art and science table and integration of my activities (discussed above), Annette also did the following: 1) encouraged me to demonstrate art techniques and science ideas, 2) modeled aesthetic experiences with science ideas, 3) counseled me on appropriate expectations of students' interests, and 4) took full responsibility for student evaluation which allowed me to focus on things like art experiences.

Demonstrating art techniques and science ideas

If I wanted the students to learn certain science ideas, as well as how to draw what they saw, Annette suggested I demonstrate how to do that for them specifically before I asked them to do it on their own. Annette's insistence that I use techniques (and the art and science materials) in front of the whole group and once before each small group session with the students is Vygotskian, as well as practical, in nature. For example, it was naïve to think fifth graders would

know when they needed more specific direction with the drawing techniques and when they needed to continue on their own (something Dewey said students could do as they moved along in their inquiries). Although Dewey must have been talking about longer activities/inquiries, it is impractical (arguably impossible) within the culture of public elementary schools to establish a classroom culture/environment in which the students create their own curricula (plans and actions or as Eisner (2002) phrased that connection – form-content).

Specifically in terms of learning how to draw, Dewey's notions of art experiences were well expressed, according to Jackson (1998) in Franck's (1973) text which gave little discussion of specific methods (form) and no step-by-step instructions. Although I had not seen or read Franck's text while co-teaching with Annette, my notions of the best way to learn how to draw were strikingly similar, equally uninhibited by prescriptions and 'how-to's,' and focused on natural things and nature as preferred subject matter. Indeed, I had thought it would be best if students discovered how to draw the way I had, with the encouragement of a supportive instructor, but mostly on their own, by really *looking* at what they were drawing. My perceived failures teaching on my own in Unit One convinced me to listen to Annette's suggestions when she gave them. Therefore, the first thing I did with the students at the beginning of Unit Two was to demonstrate the two drawing techniques one in front of the whole class and once for each small group (see Figure 5.12 below). While my drawing in front of the students was fully intended to help them, Annette demonstrated her excitement for science teaching in a way that was unintended but no less helpful.

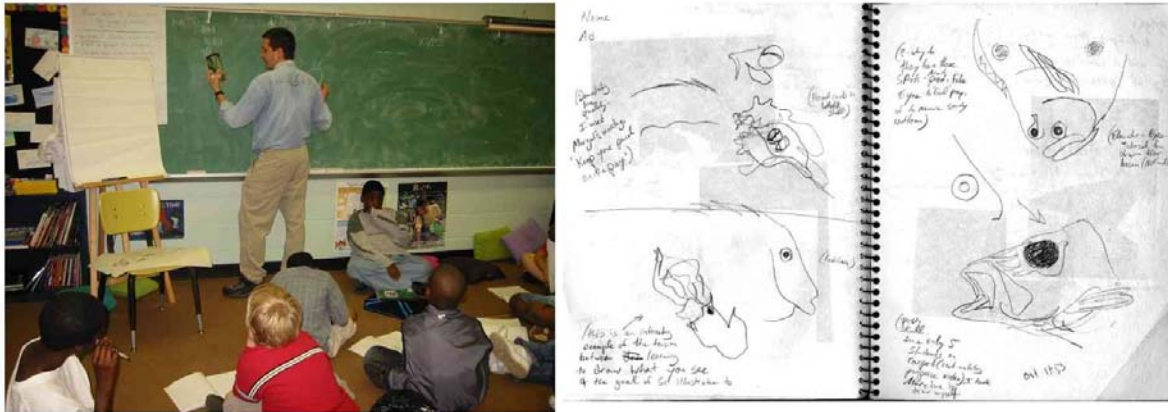


Figure 5.12. Examples of demonstrating drawing to learn science – at left, demonstrating for the whole class, at right, examples in my field journal drawn for small groups (10/30/2003).

Annette's modeling of her own aesthetic experiences with science ideas pointed to Jamie's burnout as a science educator

Working with Annette provided me with an example of a classroom teacher who could still have aesthetic experiences with science ideas while in the fray of it, while being bombarded by the stresses and requirements of classroom teaching. To see Annette's excitement at opening the science boxes and more importantly, at sharing the ideas and materials with the students, mentoring them, and facilitating them to answer their own science questions in their own scientific ways was truly inspiring.

Annette often showed her excitement for science. "Wow," "awesome," and "how cool!" were all said with gusto in reference to science ideas. She got especially excited by the specimens and samples, whether it was the dolphin skull or rock and mineral kits. In one example, we were looking through the science materials I had brought from the Georgia Natural History Museum. With the sperm whale tooth in hand, Annette told the story of how sperm whales actually stun their prey with vibrations and then, like bats, sense the location of the immobilized squid or fish using those same vibrations. It was a story told by someone really

imagining the scene, complete with pantomimed movements and descriptions like “dark, cold depths of the ocean.” Annette’s enthusiasm for teaching science allowed me to question my wavering interest in such matters.

Annette was pragmatic about students’ differing levels of interests

Students’ varying interest levels makes it very difficult to ‘facilitate’ art experiences for all individuals. While it is obvious that a teacher can not succeed in reaching all students all the time, my competing referents meant my expectations were often unrealistic. The photo below signifies one instance where a student sat at the art and science table, but had little interest in drawing the science objects in front of him.



Figure 5.13. Tarek far more interested in drawing cars than pickled fish this day. I showed Annette this picture during recess the next school day.

“That’s what he did yesterday?” she asked. “While he talked to the kid behind him” I replied in frustration. Sensing my disappointment, she said calmly. “Send him to me or any kid that doesn’t work for you. But don’t worry, there’s always going to be kids that don’t really care about a certain topic or activity we do with them.” (10/19/2003; conversational interview). Through supportive reminders like this one, Annette helped me bridge my expectations with what was realistic to expect.

Assessment (Jamie did not have to do it)

The fact that I did not evaluate (‘grade’) the students’ work was another factor that made it possible for me to work within my competing referents by allowing me not to confront that particular difficult task. Early in unit one, Annette and I agreed it would be best if I did not do any of the grading, since the students were used to her system and she was ultimately responsible for it. Whenever I did study the students’ notebooks or work, it was oriented towards improving the activities for the next time. Even so, I still found myself looking at their work and intuitively wondering two things, what ‘science’ did they really learn, and did they really ‘get into it’ (i.e. have an experience in doing the activity). Indeed my questions never stopped. In turning to what made our collaboration productive in light of differences, I discuss two important strengths I brought to the partnership in the next section.

Jamie’s strength in self-reflection (ability and self-confidence to explore weaknesses)

If I had not been thoughtful and reflective, carefully recording those things while I was in Annette’s classroom, it would have been much more difficult to de-construct these competing referents. Furthermore, it was possible to realize the ways these beliefs about teaching and learning played out in the study mainly because of the questions I asked of myself and of

Annette. I claim to have a high intrapersonal intelligence (Gardner, 1988). Like the teacher in Zembylas' (2002) case, throughout this study I was always very self-reflective, especially in gauging and exploring my own experiences as a classroom teacher. In fact, I could become too introspective – to the point where it was debilitating (in that I would become so consumed with my own emotions that I failed to just 'get the stuff done'). On the opposite end of the scale, Annette was really good at moving forward, or as she put it, 'checking it off the list.' And considering the stress she was under, to maintain that ability, to remain effective at the myriad of little tasks requiring quick decisions, meant she did not do what I was so willing to do – look inward.

These tendencies meshed well with our own self-interests within the collaboration – me with my inquiry into teacher learning and Annette with her teaching roles requiring constant clear and swift decisions. And although one of my main roles was one of questioning, the fact that it was within a collaborative environment meant there were limits to what was fair to problematize. .

Jamie did not 'judge' Annette's instruction/science knowledge; instead found positives and supported where possible.

Although I was highly critical of my own teaching, this did not transfer to my view of Annette's work. Instead, I saw Annette as an excellent teacher. I had enough experience to know how difficult it was to not only try, but succeed at teaching the way Annette taught. Whenever possible, I tried to remind Annette of how awesome I thought her teaching was with specific examples, especially when I heard or saw things the kids did or said that she might not recognize. At the same time, I tried to refrain from comments or questions that might be construed as negative criticism of Annette. Rarely did I disagree with Annette's decisions

anyway. When I did, it was a question of something that did not fit with my personality (but did with hers), not something that crossed the line as inappropriate for any teacher to do.

Annette: I rarely collaborate with other teachers. I'd rather just not be bothered with all that.

Jamie: really. That was one of the hardest things for me when I taught high school. I couldn't stand being alone on my little island. But there was not time or energy to do anything but that. Even so, I was always trying to work with the other teachers, those I wanted to work with that is.

Annette: Not me. Leave me alone and I'm happy.

Jamie: Huh...

Annette: I did work with a teacher at my old school some. It was fun, but wasn't like I had to do it, or that it was that important to me. I don't know, I just don't like to collaborate with other teachers.

Jamie: But...aren't we collaborating?

Annette: This is different.

Jamie: What's different?

Annette: You don't work here, you're from the university.

Jamie: Okay...

Annette: ...It's safer to work with you, I don't know.

(11/14/03, conversational interview)

I worked hard to not judge or interfere with Annette's decisions that were outside of our work together. Based on my perceptions of her level of daily stress, I never wavered in this effort. This

most likely was what lead to her perceptions that I was ‘safe to collaborate with,’ even when we saw questions within the scope of our partnership often quite differently.

Conclusions

The three templates described above go a long way in explaining the specific narratives in Chapter Four and the overall research experiences. In summary the templates are:

- Template one: the researcher and classroom teacher’s differing views of science determined the tools used to teach science with the visual arts
- Template two: a question of epistemological fit: Jamie Dewey co-teaches in Annette Vygotsky’s classroom.
- Template three: seeking and finding balance through collaboration

These templates go to the heart of classroom teaching. Our epistemologies and notions of how best to teach students subjects such as science are normally invisible and implicit in nature. However, through collaborating and co-teaching (as well as subsequent analysis), these matters of our ‘teaching hearts’ became perceptible and understandable to me (and to every possible extent, I hope to you as well).

In the final chapter, I discuss implications for the research after summarizing my findings within the context of the literature and the study’s guiding questions.

CHAPTER SIX

CONCLUSIONS AND IMPLICATIONS

The purpose of this study was to explore how two teachers collaborated to develop and implement science units using the visual arts. Research focused on the nature of the relationship that evolved over the course of the partnership and the type of learning about teaching that occurred in the interactions between participants.

As an arts-based narrative inquiry (Diamond and Mullen, 1999), I explored teacher learning (including my own) in the context of two interrelated questions: 1) how can the visual arts be used to teach science, 2) how can a classroom teacher and a university researcher collaborate and co-teach within the complexities of one classroom within a university-school partnership. I used a variety of data collection methods: conversational interviews, audio and dialog journals, and visuals such as student and researcher drawings, paintings and digital photographs. Data analysis involved developing and refining specific narratives (teacher cases and touchstone events). After writing these illustrated stories, I conducted an analysis across the stories and the field texts (analysis of narratives) to construct schematic narrative templates – three tensions that explain the connections between the specific narratives.

In this section, I discuss the findings within the context of the research literature, organizing major points according to the guiding questions. Implications are drawn for practice in elementary science classrooms as well as those for science teacher education. Methodological implications are described, as well as suggestions for future research.

Factors that facilitate and constrain using the visual arts to teach science

The first guiding question concerns the features that helped and hindered planning and teaching the science units using drawing and painting. A description of key tensions is included, especially where it is unclear if the factors help or hinder instruction. The label research-coteacher refers to me, classroom-coteacher to Annette.

Facilitating Factors

- Art and Science table
- Classroom-coteacher established existing environment of positive science learning and effective classroom management
- Research-coteacher's large investment of time, energy, and resources - including high quality science and art materials
- Personal experiences in art and science and advice from peer debriefers

Constraints:

- Research-coteacher's orthodox view of what counts as science
- Time/energy constraints
- Research-coteacher's self-imposed pressure that quality of the teaching units be worthy of dissertation research

Tensions:

- Research-coteacher's open-ed goal of using drawing/painting to teach science as exploration in teaching (without specific plan or defining model) meant: practice not constrained by predetermined limits $\leftrightarrow$ little guidance from literature/past experience specific to teaching science using art

- Researcher's bias towards scientific illustration $\leftrightarrow$ against more creative art activities

What made teaching science using art possible?

As mentioned in the concluding remarks of Chapter Four, I denote what might have been the most common tension 'swirling around my research experience'...were the visual arts really making science learning possible? Based on my subsequent analysis, I am no closer to answering this question with a simple 'yes or no' than when I was in the midst of teaching science using art. However, I have a lot more to say about it, especially in light of those factors that facilitated and constrained science and art integration. In the next section, I describe the bulleted claims above in answering that question.

Annette had already established an environment of positive science learning and effective classroom management before I started, allowing me to fit into her room without having to worry about establishing expectations. Possibly more than any other factor, the 'art and science' table made teaching science using the visual arts possible. In unit one, I perceived few successes in working with the entire class. Annette suggested and facilitated my work with small groups of students at a large table in the back of her classroom. This meant I only needed enough materials for six students (often less). Like Roth, et al. (2001), in taking this 'divide and conquer' approach in units two and three, I gave a few students a lot of attention. We established routines for working at the art and science table that helped the fifth graders know the expectations. Roth, Tobin, and the other coteachers, however, often switched groups and did not have the same routine. They worked with high school students and had up to six coteachers at a time.

The opportunities of having a university coteacher working at the elbow of the classroom teacher allowed us to teach in new and innovative ways. These opportunities are consistent with

Whitin and Whitin (1997) and Tobin and Roth (Roth, et al., 2001; Roth, Lawless & Tobin, 2000; Tobin, Roth & Zimmerman, 2001), who also profess to teaching in ways that are not possible in typical one-teacher classrooms.

Similar to States, et al (1993), my position at the university meant I had access to high quality science materials. Indeed, many of the items I brought were novel and exciting not just to the students, but to Annette as well. My position as a professional visual artist also meant I brought in high quality art materials, as well the skills to mentor students in techniques generalist teachers, including Annette, most often lack. Numerous projects in the art education research have found working artists valuable resources for classroom teachers (e.g. Upitis, et. al, 2001).

Since it was my dissertation project, I also was very willing to make a large investment of time and energy to find ways to use art to teach science. In addition, money was made available through a grant from the university and my own personal expenditures. This is another reason the students could work with high quality art and science materials. I started using expensive watercolor paper after the school art teacher told me, “Artists, like Picasso...he didn’t need pricy materials to create beautiful things. But the less experience you have, the better your materials should be.” (10/23/03, conversational interview).

Many factors contributed to the development and implementation of the arts-based science units, including the high quality of science materials, art supplies and skills accessible because of my position at the university as well as my experiences as a working artist. This is consistent with State’s et. al, (1993) claim that university scientists improve science classrooms because of their access to expensive science materials. The art education literature also points to the value of professional artists working with classroom teachers (Walker, 2001; Harvey, 2002), including projects to integrate art into other subjects (Upitis, et. al, 2001).

How resources are allocated and related decisions can have great impacts on classrooms (MacGregor, 1993). As part of this study, a small grant and personal investment made much of the science and art resources available. Annette and I worked hard to put those resources to the best use while honestly communicating with each other about the boundaries. Annette shared on occasion that my use of resources was at times too generous for her and the students, but that it was helpful, appreciated, and well intentioned.

Since the units were a central component of this dissertation study, much of my time and energy went into creating them, far more than Annette alone could have spent. The mental investment that was put into the units inevitably facilitated their development and refinement. However, as discussed in case 4 (about beautiful lesson plans), the pressure of this work being my dissertation seemed to get in the way sometimes. Even so, my methodology allowed me to focus on best practice. For example, advice I sought from the school's art teacher, an artist friend, and a professor in elementary science education (peer debriefer) was very helpful in clarifying my thinking as well as providing ideas for better activities and methods.

As discussed in my subjectivities in Chapter Three and Template One in Chapter Five, I believed in one approach to learning science using art above any others – that is, to teach drawing skills in an effort to render science objects. During the study, I took a scientific illustration course from the art school. Specifically in art and science, these courses lead me to a series of powerful and exciting *experiences* (Dewey, 1934). It also strengthened my bias towards representational drawing in teaching natural history. In fact, many days I went directly from the art school to the elementary school. While there is much support for this type of art to teach science (Hodges, 2003, Leslie, 1995; Gainer & Child, 1986), others in art education have warned of the danger of being too skill oriented when teaching drawing at the expense of discovery and

risk-taking (Unsworth, 2001). Annette maintained a distance on these integration issues, claiming it was not her expertise.

The exploratory nature of my work, with its emphasis on studying practice while (and as part of) improving that practice allowed me to explore different methods of teaching science using art without being married to one model or approach. At the same time, without boundaries typical to many studies of best practice, including Girod's (2001) dissertation on teaching science for aesthetic understanding, I received little guidance or help from predetermined plans and formal categories like interdisciplinary vs. integrated curriculum models. For example, these theories seemed so clear to me around the time of my research proposal defense in April, 2003. However, like Roth (1998) found in his work with preservice and new teachers, I was abruptly made aware of the difference between talking about practice in the classroom and practicing in the classroom. That is, my perceived inability to teach science using art in unit one in June, 2003 lead me to reject the value of predefined categories like interdisciplinary curricula and theoretical ideas like 'curriculum as reality' (Lovet and Smith, 1998). Instead, with the help of Annette, I sought to teach in ways that seemed best within the specific but changing context of her classroom. This is more consistent with praxology (theory through practice) of Roth et al. (2001) and Tobin, et al. (2000) in which practice and theory were so intertwined with, and resultant from, the specific classroom situations. The ideas and practices I gleaned from this study make more focused inquiries possible (see implications for future research below for more).

Conceptions and the relationship of curriculum to teaching

In my second guiding subquestion related to using art to teach science, I explored my own ideas (and possible changes in those ideas) of teaching and curriculum. I answered this question (at least in large part) differently depending on two related factors: 1) my major

research task and 2) my location. Using these factors, three stages are defined that account for my conceptions of curriculum and teaching and changes thereof: Stage one: planning the study/teaching at the university, Stage two: co-teaching with Annette in the classroom, Stage three: analyzing data/making sense of co-teaching experience back at the university).

- Stage one: planning the study/teaching at the university:
 - I was attracted to more complex, theoretical concepts, but I was not forced to apply any (except in providing a rational/theoretical framework for my prospectus)
 - Many different ideas made sense; for example, curriculum as personal journey, different for each student.
 - Teaching included intended curriculum and unintended curriculum (unintended often negative in terms of power/marginalizing)
- Stage two: co-teaching with Annette in the classroom:
 - I sought more straightforward, definable, and limited concepts
 - Annette's influence is large – "Curriculum means the state objectives."
 - Teaching meant how plans were implemented based on the QCC's (curriculum).
 - My perception was that Annette is good at planning (curriculum); Jamie is bad at planning (curriculum).
- Stage three: analyzing data/making sense of co-teaching experience back at the university:

- o Curriculum-teaching integrated into approaches. I viewed Annette's ideal curriculum-teaching approach as epistemologically different from my ideal curriculum-teaching approach
 - Annette was clearly proficient at implementing her (Vygotskian-based) approach, and this was clear in analysis.
 - I was not proficient at implementing my 'ideal' (Deweyan-based) approach for many reasons: 1) competing teacher referents meant 'my' curriculum-teaching approach was difficult to define/understand and often conflicting, 2) my lack of elementary experience, 3) my 'ideal' curriculum counter to culture of schooling.

These three stages represent changes in my conceptions of curriculum and teaching, especially related to my oscillating beliefs of the value and use of theory informing educational research at the university versus classroom practice. While this study made explicit efforts to merge my worlds of university research with classroom teaching, ultimately I was unable to unite them, at least in terms of my conceptions of curriculum/teaching.

In stage one, while planning and defending the study, I was attracted to more complex, theoretical concepts. Indeed, this is the currency of power at the university, as Hayes and Kelley (2001) noted from their experiences in elementary science education. Like Hayes, I believed that my theoretical knowledge could help me help classroom teachers. Practical knowledge did not hold the same weight, and, while I touted its value, I was acculturated into a system that held it in lower regard compared with theory.

During this prestudy Stage One, I explored and valued ideas like curriculum as personal journey (Lovet and Smith, 1998) and teaching/curriculum as a complex web of interactions. Another attractive conception of this relationship was that teaching included intended curriculum and unintended curriculum (Lovet and Smith, 1998). Thus, these complex theories and definitions were useful at the university in, for example, defending my rationale for my collaborative exploration with Annette.

As the next stage of the study began, I did apply these ideas in teaching Unit One. However, it soon became clear that they not seem to impact what we did on a day-to-day basis. For instance, early in the study I asked Annette what she thought of Pinar's definition of curriculum as an educational experience or personal journey. The dialog was brief:

Annette: That sounds like something that could be very interesting to talk about in a graduate class in the College of Education.

Jamie: And...

Annette: As for what I do here in the classroom, I don't have much use for stuff like that.

Jamie: So what is 'curriculum?' How do you define it.

Annette: It's the QCC's, the objectives I start with to make my lesson plans. My job as a teacher starts with that curriculum, at least in this state. With as little time as I have, theories about curriculum end there too.

Jamie: Huh...

Annette: I'm not trying to tell you what to believe though...you just asked me and I can't use something like 'personal journey,' not with all I have to do everyday. (6/10/03, conversational interview).

It was not long after that (still in unit one) that I was finding the same personal truth about the usefulness of such theories. Hayes & Kelley (2001) also noted their tendency to value theoretical ideas over the practical knowledge of the classroom teachers they worked with, while failing to integrate them and in some cases, failing to teach well. Roth (1998) found new teachers from his program were upset that the theories they ‘bought into’ while at the university were not helpful to their practice, as I found in teaching Unit One.

Like Roth, Tobin and their coteachers (Roth, et al., 2001; Roth, Lawless & Tobin, 2000; Tobin, Roth & Zimmerman, 2001), my beliefs about curriculum and teaching were affected by my practice and conversations with Annette. Ernst (1994, 1997) shared similar experiences in the ways her teaching lead to theory which affected her teaching, especially as she collaborated with her colleagues.

Entering Stage Three (data analysis and writing) meant a return to the university with its currency of theory. It was in the analysis of the stories written soon after exiting the field, that the theories really began to facilitate my understanding. For example, while I had some notion of the value of Dewey’s (1934; Jackson, 1998) *art experiences* going into the study, it was not until I was forced to apply it that I started returning to more theoretical conceptions of curriculum and teaching. Reading the theoretical work of Glassman (2001) and Girod (2001) allowed me to understand my ‘ideal’ approach (which integrated curriculum and teaching) and how it was consistent with Dewey. I was also able to find examples and reasons why I failed to implement my ‘ideals.’ Furthermore, I constructed claims about how those notions and realities interacted with Annette’s more Vygotskian ‘ideal’ approach. I had come full circle, back to using the currency of the university. Consistent with Hayes and Kelley (2001), even my failures in the

classroom were useful, so long as they could be theorized and integrated with theory. Next, I discuss issues related specifically to the collaboration.

What factors helped and hindered our collaboration?

Numerous factors facilitated and constrained my partnership with Annette.

Facilitating Factors

- Coteachers had a great mutual respect for each other – differences seen as strengths.
- Traditional power differentials between university researcher and classroom teacher were decreased for many reasons, including:
 - o Classroom coteacher was able to bridge traditional university-classroom gaps
 - o Issues of gender and ethnicity, while not part of the study, were discussed; the partners were not typical of ‘stereotypical power relationships’
 - o Communication and negotiation was constant, open and honest – in terms of: 1) Time and resource allocations, 2) Respective roles and goals of coteachers, 3) Respective self-interests and mutual interests

I likened Annette’s classroom to an island – we were more or less isolated from the larger partnership between her school and our university. At the same time, I felt welcomed on that island. That meant the stresses outside of her room did not directly interfere with our work together. Annette’s preference for isolation is consistent with the research (Lortie, 1975; Hargreaves et al., 2001). Furthermore, in recent university-school partnerships, Hargreaves et al. (2001) found teachers isolated themselves even more under the pressures of school-wide change. Increased testing and demands like additional meetings resulted in further seclusion (Brandt,

2004). Consistent with those findings, Annette shared these stresses and her responses to them with me when I asked directly. Even so, I perceived I was shielded from those pressures she faced as the classroom teacher. Unlike many of the other partners from the university, my work at the school was limited solely to Annette's classroom, except for the handful of conversational interviews I sought with the school's art teacher.

Issues of power and nullifying power differentials

I frame a lot of the ways Annette and I were able to work well together in terms of Hayes and Kelley's (2001) description of how issues of power affect and ultimately get in the way of collaboration between classroom teachers. Both Hayes and I entered an elementary school with the explicit goal of using our expertise to contribute to science education. This in itself is an example of our position of power – we were both 'experts' from universities and believed we could 'help.'

While Hayes volunteered as a science coordinator for the whole school, I entered into collaboration with only one teacher in her classroom. In my case therefore, any issues of power were solely between me and one teacher. And in the wonderful case of Annette, the power differentials that might normally exist between a male university science educator and a female elementary teacher were nullified in many respects. Annette herself was finished with her Ph.D. coursework in language education and was not intimidated by, or ignorant of, educational theory or research. Furthermore, her interest and experience with science courses and teaching meant she welcomed me as a kind of an equal. I was someone who might know more about some science concepts and about art and science connections, but she was someone who knew more about how to teach science to fifth graders. This difference in knowledge and experience became clear to both of us during the planning and teaching of unit one.

Issues related to gender were something Hayes and Kelley (2001) suspected added to the power differential experienced between Hayes and a female teacher. However, Annette and I, both come from (and currently are part of) families with strong women, Annette (in her reserved way) being one of them. And while (Snider, 1993) suggested holding meetings on neutral territory, our collaboration took place in Annette's classroom, where her status was unquestionably strong.

As States, et. al. (1997) discuss, scientists can provide resources to their teacher partners that have decidedly positive impacts on classroom teaching. However, MacGregor (1993) warns of issues related to how infusions of money and resources can get in the way of collaborations. Through a grant as well as out-of-my-pocket, much was invested in our collaboration. This certainly related to questions of power, and we tried very hard to be honest with each other about the boundaries and expectations involved here – that communication as well as constant negotiation helped to make the give and take of money/supplies focused on using our resources in productive ways, at least from my perspective.

In terms of the factors that constrained our collaboration, I can only construct one factor, but it is large in its negative impact. I discuss it below, as it relates directly to the last guiding question.

Comparing my perceptions and experiences with those of the classroom coteacher

The ways I experienced the events of the study were quite different from Annette's. As mentioned above in referring to constraints in the collaboration, the only factor worthy of discussion concerned the limited time and energy Annette had to give our partnership. However, this issue had an immense impact on my entire study. While I had and gave a lot of time and energy to the collaboration, I was also under comparably few external pressures. On the other

hand, there were immense demands on Annette's time and energy from factors outside of our collaboration.

The issue of time and energy related directly to one of the most pressing tensions that ran throughout the study – teacher burnout. During the time in which the study took place, Annette and I were both at intersections in our careers. I had already experienced burnout as a teacher (I will talk more of this below), while Annette was very much in the process of becoming burnt-out. The friendship I developed with Annette (and her family) during the study, and my empathy for classroom teachers in general, combined to make me want to do everything in my power to help Annette. Her life was very busy – working on her own Ph.D., being the sole earner for her family (her husband was a stay-at-home dad), mothering her infant daughter, and working as a classroom teacher in a CSR-partnership school that demanded extra time commitments (not to mention additional high-stakes testing).

At the same time, and like any collaboration, I had my own self-interests to meet, not the least of which was the tension created by engaging in a doctoral dissertation within Annette's classroom, a process that traditionally does everything possible to maintain distance and impartiality between teachers and researchers. While this was certainly not part of my methodology, it nonetheless, meant that I was forced to examine how much I could help Annette from my own privileged perch at the university. Without going into the details, I am still very disturbed by the systemic problems and pressures within our public schools and universities (colleges of education) that lead to classroom teacher burnout. While Annette expressed to me in numerous ways that I helped her and was not part of the problem, ultimately, there was little I could do to stop her own burn-out. My experiences beg the question of university researchers' roles in classrooms and their work with teachers; questions highly complex, context-dependent,

as well as highly personal. I can only say that I am very grateful to have had the chance to explore these issues as part of my dissertation without the constraints that can be imposed (and often embraced) by educational researchers.

I learned (again) that the classroom is an incredibly complex place and a place where it can be very difficult to feel successful. But returning to the intersection noted above, I am grateful for the experiences this dissertation and Annette afforded me to reclaim my passion for science teaching and learning. I have been very blunt about my past beliefs concerning the limitations and irrelevancy I saw in science education. This negative attitude can now be expressed even more directly because (I hope) it is now in my past. My emerging positive and optimistic attitude is based on my experiences in the study: the ways Annette and I found to utilize my strengths and build on my existing passions for visual arts in teaching science, and my increased knowledge of Girod's (2001) approach to teaching science for aesthetic understanding.

While classrooms remain a daunting challenge for me (and most educators who are not delusional), I find great hope in the prospect that I can use what I have learned from my experiences with Annette to engage in future collaborations with classroom teachers.

Implications for practice

For elementary science teacher educators

Based on my experiences from this study, I echo Fu and Shelton (2002) in their suggestion that university educators should “co-teach classes in public schools, in order to try their ideas in real classrooms, to work with real children and refresh themselves with real classroom experiences” (p. 101). I would add that real collaboration forces university partners to take hard looks at the value of theory and pie-in-the-sky ideas so easily floated in teacher education classes; at least this was what Annette and I discussed on occasion.

My work in Annette's class will surely influence the ways I teach the methods class this coming fall – for example, I am starting to think about using Katz and Chard's (1989) long-term projects as a core of the class. Even so, my experiences with Annette cannot help but remind me of the tensions created by high-stakes testing and other constraints on student-centered instruction.

For elementary science teachers

This is the story of the value of practical knowledge and how teachers have much to teach university 'experts' like myself. There exists the impression that university researchers can help partner teachers improve instruction through partnerships (Hargreaves et al., 2001). However, my perception was that this 'expert' learned far more about improving practice than the classroom teacher (the ways I was able to improve instruction were made possible by Annette, not the other way around). This notion that teachers' practical knowledge is of great value is not new to researchers (Connelly & Clandinin, 1988; Clandinin & Connelly, 2000; Cole & Knowles, 2000) or some practicing elementary teacher-researchers (Hankins, 2004; Gallas, 1994 & 1995; Ernst, 1994 & 1997). However, as Hayes and Kelley (2001) described, there are prevailing cultures whereby universities and theoretical knowledge yield power over elementary schools and practical knowledge.

Classroom teachers that may get their hands on this report hopefully can find support and inspiration in trying to blur the boundaries between research and teaching in their own work. More specific to this study is that classroom teachers have so much to teach university researchers and teacher educators (e.g. Clandinin & Connelly, 2000). University partners like me can have incredible skills, knowledge, and material resources to bring to classrooms. But like

me, most will need the help of classroom teachers (like Annette) to have positive impacts on students' learning and experiences.

For educational researchers (methodological implications)

I ended the previous section with a call for classroom teachers to help their university partners teach students. However, given constraints classroom teachers already face (Hargreaves, et. al, 2001), I cannot stress enough that we, as outside partners, need to do everything in our power to be aware of and work within the multitude of constraints teachers like Annette face everyday.

Even though I was a university partner at a Comprehensive School Reform (CRS) school, my study was limited to only one classroom within that school. Given its limited size, this project definitely fits into Barah and Luehmann's (2003) disparaging category of a "boutique study." In other words, my study was too small to lead to systemic change. While I agree with the need for systemic change, I also claim that there needs to be a place 'at the table of dissertation research' for boutique studies, just as Barone and Eisner (1997) call for arts-based educational research to have a place at the larger table of educational research.

Dissertations projects that are exploratory, collaborative and use arts-based narrative inquiry are messy and questions result far more often than 'authoritative claims' (Diamond & Mullen, 1999). However, I have been able to establish a repertoire in my interactions with other elementary classroom teachers since my own 'boutique study,' not because of the potency and authority of my claims; instead, it is my ability to empathize and relate to the difficulties and realities these teachers face everyday. For if I learned nothing else, it was because I tried to teach as part of my study that allowed me to see how incredibly difficult and complex it is to be a successful elementary school teacher.

Implications for future research

Due to the limited scope of this study (like any research endeavor), inevitably questions went unexplored. For example, since the focus of the study was on teachers, much of what occurred in terms of student learning and their experiences remained something of a mystery – at least compared with how much I learned about Annette and my own experiences. Whenever I shared this with Annette, she said something like, “that can be your next study, you can’t do everything” (1/7/04, conversational interview).

Another topic most worthy of further exploration is that of using the visual arts in teaching science in relation to issues of diversity and equity. Our work in teaching science at Nelson Elementary School meant facing many of the inequities and tensions associated with urban science education (Tobin, et. al, 2001; Roth, et. al, 2002). Important questions might be: How does trying to use the visual arts to teach science relate to issues of diversity and multicultural education, especially in classrooms and students marginalized by deeply-rooted societal inequities? How can educators overcome the deficiency models so often associated with urban settings in relation to using the visual arts to teach science?

Tim Rollins, the nationally renowned art educator mentioned previously (Rothstein, 1986), visited Nelson Elementary and gave a moving presentation to the students during my time co-teaching with Annette. He had a lot to say about the visual arts as a powerful tool for dealing with inequalities his students faced in New York City. His direct references about racism and violence among elementary students he taught reminded me of how little I might have known about the students I worked with at Nelson. Did my bias towards scientific illustration make it harder to relate to students who might be less comfortable with nature than, say, rural students?

Did the subject matter and examples favor kids that looked like me? Many inquiries are possible in this area.

My own experiences within this study corresponded with that of several art educators (Unsworth, 2001; Edwards, 1989) – students around the time of fifth grade are at a critical period in visual arts. Without the proper instruction and opportunities, they will quit their pursuits in the visual arts, citing the common claim, “I can’t draw.” Related to learning science, it meant that students were not openly resistant to drawing to learn science, but sensitive to whether their drawings ‘worked.’ If they did, I found the students were often very excited about doing more art and science activities. Without my feedback and suggestions, however, the students were often opposed to any future science and art activity.

Is it true that students who have not moved beyond this ‘critical’ period will not be open to drawing to learn science? My own limited experiences with students in first and second grade is consistent with those of Gallas (1991, 1994 & 1995), who found that young children draw with confidence and enthusiasm, without needing instruction or suggestions that older students require. What can they gain, however, from science and art activities in which some of the tenets of scientific illustration are taught?

On the other side of the coin, what ways can students gain from art and science activities whereby creativity and risk-taking are encouraged without any emphasis on rendering accurate or realistic drawings? While Gainer and Child (1986) found this threatening to many students, the prospect of teaching drawing can be equally threatening to many teachers (Unsworth, 2001). The tensions these questions created in this study offer many possibilities for future inquiries centered on teaching science using the visual arts. Surely, many more questions await our attention.

Conclusion

I conclude as I started, with images of student work that inspired my own artwork. Viewing the fifth graders' landscape watercolors, those framed and hung for the art and science exhibition, reminded me of the brief but exciting interaction I had after my time in Annette's classroom. I was in a local department store when I saw one of the fifth graders (who had moved on to middle school by that point).

"Ty," I said, "How are you?" His face lit up, which surprised me a little; I didn't remember him interacting with me in an overly positive (or negative) way. "Hi, Mr. Jamie," he said, passing by with two family members. "It was great to see you!" I said. I meant it, after seeing the excitement in his face. But as they continued down the aisle, it was what I overheard that meant the most to me. "Who's that?" I heard his older sister ask. Ty replied, "You know my painting...yeah, the one hung in the living room, he's the one..." His words became unintelligible in the distance. But the enthusiasm in his voice and the thought of that beautiful colorful painting hanging still in his living room – it is wonderful to behold. Stories and images (like his painting below) make me hopeful that I was not the only one who benefited from this study.

By way of a link to the future, I've included a painting I did for Mike Hayes, the author so often cited for his article, Hayes and Kelley (2001). I appreciated his work so much that I contacted him to offer the gift of a painting. He asked for a painting of the 'Palouse' in Idaho – I hope he likes it as much as I like Ty's painting. Who knows, it could lead to my next collaboration in art and science.



Figure 6.1. The painting done in January, 2003 by Ty (based on Martha Odom's 1975 painting, 'Fireweed and Fish Traps')



Figure 6.2. My painting of the Palouse, near Moscow, Idaho for Mike Hayes, April, 2005

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Appendix A: Dates/Times in Field, Teaching Unit Two and Three

Dates/Times in Field, Teaching Unit Two and Three		
Dates	Description	Etc.
10/20/03 Monday 12:20-3:30pm, 3 hrs 10 min.	Annette taught sci lesson – first day of unit (I gave 3 min) spiel, lots of chatting and planning (conv. Interv)	Annette taught everything – different from the pilot
10/21/03 Tuesday 12:10-3:30pm, 3 hrs 20 min.	Same as above, Tim Rollins assembly	I blew my 10 sec, need to email Tim Rollins, missed Adderall – it hurt.
10/22/03, Wednesday, 12:17-3pm	I modeled gesture/half blind contour to class on carpet, art table – two groups	Annette took pictures of carpet teaching
10/23/03, Thursday, 11:56-3:40pm	Quiet Reading, Lunch, I taught one table art, brag assembly, assisted with salt experiment.	First Art Teacher interview, lots of pictures taken, Annette really tired.
10/24/03, Friday, 12:14-2:46pm	Lunch/recess, table art, dolphin video	The Tarek experience
10/27/03, Monday, 10:55am-1:17pm	Science – ‘assisted’ Annette with science – salt lab, list adaptations of dolphins, and jar critter disc.	Lunch in room, prep for Tuesday after school
10/28/03, Tuesday, 10:50-11:58am	Adaptations in Jars – table art – no audiotape	Annette at intech, ms. Principal sub, counselor visit, sci shifted – parent conference days
10/29/03, Wednesday, 11:05-1:15pm	Annette back, Adaptations in jars – table art with ‘tough group,’ 2 classes had lunch in room	No time to talk, that group was tougher, but Dominic did beautifully
10/30/03, Thursday, 10:45-11:55am	Adaptations in jars III, seven students to five, lost Zinia and sent Miguel away	Annette at InTech again, I missed first 20 min. of audio again
11/3/03, Monday, 12:55-3pm	I was sick and just observed, Annette discussed project requirements, deep sea article	Reminded me of how hard it is to teach when you’re ‘down’
11/5/03, Wednesday, 11:23am-?	I helped students print out info, I helped a little in the computer lab (11:23-11:45)	Discussed grid drawing lessons with Annette. Spectrum students in DC for week.

11/6/03, Thursday, 1-3:30pm	Taught grid lesson #1, drawing mixed up boxes into cat	Worked with whole class, harder than I thought and exhausting
11/10/03, Monday, 1:07-3:30pm	Taught grid lesson #2, drawing killer whale line drawing	Got easier – changed my expectations a bit – still hard (to teach drawing)
11/11/03, Tuesday, 12:33-2:55pm	Taught grid lesson #3 to first group	Dominic was tough, told Shay I'd get her a larger bull shark (never did)
11/13/03, Thursday	Grid lesson #3 to Kiara, Danny, Ty, Roy and Miguel	Good success with exercise
11/17/03, Monday, 1:07-2:57pm	Drawing lines on the basketball court in small groups	Another Tarek experience, asked to draw Iceberg the retired pimp.
11/19/03, Wednesday, 11:47am-1:40pm	Packed up, Talked with Annette, drew kids	End of unit one field experiences
Unit 3 Dates/Times in Field Chart		
12/8/2003, Monday, 1:08-2:40pm	Reentry into field (hard), Annette finishing up social studies	I mostly drew students, Tareks' toy car, hard to get back into swing, no audiotaping
12/9/03, Tuesday, 1:05 - 3?pm	Annette's intro to unit 2 (landforms), I helped a few students with their notebook drawings	no audiotaping, did some planning with Annette (afterschool?)
12/10/03, Wednesday, 12:50-3?pm	Katie made brownies, Annette taught with em, I demoed landform drawing on chalkboard	teaching taped, recess inside - cleaned fish tank
12/11/03, Thursday, 12:57-3:15pm	first table art with landscape watercolors	Annette picked easy group on my request, I used drawing paper instead of watercolor, Roy, Shay, Kiara, Frank
12/12/03, Friday, 12:54- 3:05pm	second group - table art with landscape watercolors	Still pretty easy group, Carrie drove me batty, others include Mitchell, Hui Jung, and Roman
12/15/2003, Monday, 12:21-2:55pm	second group - table art with landscape watercolors	Jackie, DJ, Janet, Jermaine, Lindsay - left early
12/16/2003, Tuesday, 12:21-2:55pm	geode lesson	recorded, including lunchtime/afterschool conv.
12/17/03, Wednesday,	Jim photo shoot, Annette taught with sand, me at table art	Dominic, Lindsay; conv with Jim and Annette interesting
12/18/03, Thursday, 1:20-3?pm	toughest group' - table art	Maria, Allen, and Tarek

12/19/2003, Friday, 11-11:20am	dropped off sugar cookies, got students' approval for postcard images	x-mas party
1/4/2004, Sunday, 7-9:30pm	writing group	looked at pictures with Jim
1/5/04, Monday, 1:10-2:55pm	first day back, hard	Miguel, afterschool conv recorded
1/7/04, Wednesday, 12:26-2:50pm	Small Table Art - round 2	
1/8/04, Thursday,	Small Table Art - round 2	
1/12/04, Monday, 12:35-	Small Table Art - round 2	with 'easy's' - Roy, Zinia, Lindsay, Mitchell
1/13/04, Tuesday, 12:37 - 3?	Small Table Art - round 3!	Lindsay, Carrie, Zinia
1/14/04, Wednesday, 11-12:30	small Table Art - round 2 - Tarek and	Jim photo shoot, debriefing with Dr. Butler
1/15/04, Thursday	prep for show (with Jim), no Nelson	stuff to Frank in O.R.
1/16/04, Friday, 9:15-11am	Art Show Reception at university	wow, what an event!
Post Unit 3 (sense-making) Dates/Times in Field Chart		
1/28/04, Wednesday, 5-7pm	dinner at the grit	
2/5/04, Thursday	surprise party at Nelson	not recorded, Annette took so photos
march	my u class visits them	human bio mini-lessons
April/may	came to help with science	donated \$\$ for science day

Appendix B: All Audio Recordings from the Study

All Audio Recordings from the Study				
Date	Type	Subject/Title	min - side	tape/side
5/29/2003	Interview	pre-unit 1 - Annette	60 - a	1a
5/29/2003	Interview	pre-unit 1 - Annette	60 - a	2a
6/17/2003	Interview	mid-unit 1 - Annette	20? - b	2b
6/17/2003	audio journal	pre-unit 1 - Annette	60 - b	2b
6/25/2003	audio journal	pre-unit 1	30 - a	3a
7/2/2003	Interview	post unit 1 - Annette	60 - b	1b
7/2/2003	Interview	post unit 1 - Annette (backup)	60 - b	3b
9/4/2003	audio journal	post unit 1	60? - a	4b
9/14/2003	audio journal	pre-unit 2	30 - b	4a
9/15/2003	audio journal	pre-unit 2	40? - b	5A
9/17/2003	audio journal	pre-unit 2	60 - a	5b
9/27/2003	audio journal	pre-unit 2	2m - a	6b
9/29/2003	Conv Interview	writing group	30? - b	6b
9/30/2003	audio journal	pre-unit 2	30 - a	6a
10/6/2003	Interview	pre unit 2 part 1 - Annette	60 - b	7b
10/6/2003	Interview	pre unit 2 part 2 - Annette	20 - a	7a
10/14/2003	Interview	pre unit 2 - Annette	60 - a	8a
10/14/2003	Interview	pre unit 2 - Annette	60 - a	9a
10/16/2003	audio journal	pre-unit 2	60 - b	10a
10/18/2003	audio journal	unit 2	60 - a	10b
10/18/2003	Pocket Rec	saets workshop	60 - a	11a
10/18/2003	Pocket Rec	saets workshop	60 - a	18a
10/20/2003	Conv Interview	afterschool - ocean boxes	45 - a	12a
10/20/2003	Pocket Rec	classtime - kw(l) - annette	60 - a	11b
10/21/2003	Conv Interview	afterschool	15? - a	13a
10/22/2003	audio journal	unit 2	60 - b	14a
10/22/2003	Conv Interview	lunch conv	25? - a	13a
10/22/2003	Pocket Rec	classtime	60 - a	16a
10/23/2003	Interview	art ed debriefing	40 - a	17a
10/23/2003	Pocket Rec	classtime	60 - b	16b
10/24/2003	audio journal	unit 2	60 - a	14b
10/24/2003	Conv Interview	lunch	? - a	13a
10/24/2003	Pocket Rec	classtime - tarek exp	60 - a	13b
10/26/2003	Interview-db	planning - mid unit one - Annette	25 - b	18b
10/27/2003	Pocket Rec	classtime - annette teach salt	60 - b	12b
10/28/2003	audio journal	unit 2	60 - a	20a
10/28/2003	Pocket Rec	classtime - tough group, adapt jars	25 - a	19a
10/29/2003	Interview-db	art ed debriefing	40 - b	17b
10/29/2003	Pocket Rec	classtime - jars tough group	50 - b	15b
10/30/2003	Pocket Rec	classtime - jars on rug w sub	60? - a	21a

11/2/2003	Interview-db	art debriefing - John	60 - a	22a
11/2/2003	Conv Interview	writing group	30? - b	22b
11/3/2003	Conv Interview	afterschool	20 - b	21b
11/4/2003	audio journal	unit 2	60 - b	20b
11/5/2003	Pocket Rec	classtime	30 - a	23a
11/6/2003	audio journal	unit 2	60 - a	24a
11/6/2003	Conv Interview	afterschool	15? - b	23b
6-Nov	Pocket Rec	classtime	10? - a	23b
6-Nov	Pocket Rec	classtime	20? - b	23a
6-Nov	audio journal	unit 2	60 - a	24a
10-Nov	audio journal	unit 2	60 - b	24b
11/10/2003	Pocket Rec	classtime killer whale - grid2	60 - a	25a
11/11/2003	Conv Interview	lunch conv - expl murals	30 m - b	25b
11/11/2003	Pocket Rec	classtime - art and science table - grid	60 - a	26a
11/11/2003	Conv Interview	afterschool	15 - b	26b
11/12/2003	Interview-db	mid-term meeting - Committee	60 a	27a
11/13/2003	Pocket Rec	classtime - grid 3	60 - a	28a
11/17/2003	audio journal	annettes bad day	15 - a	29a
11/17/2003	Pocket Rec	classtime	60 - b	28b
11/23/2003	Interview-db	post unit 2 - Annette	60 - b	9b
11/24/2003	Interview-db	sci ed debriefing	60 - a	31a
12/10/2003	Conv Interview	unit 3 afterschool - planning	60? - a	33a
12/10/2003	Pocket Rec	unit 3 classtime - landform demodrawing	60 - b	31b
12/11/2003	Pocket Rec	classtime - art and science table	60 - b	33b
12/12/2003	Pocket Rec	classtime - art and science table	60 - a	34a
12/15/2003	Pocket Rec	classtime - art and science table	60 - b	34b
12/16/2003	Conv Interview	lunch conv	25 - b	30b
12/16/2003	Pocket Rec	classtime - geode	60 - a	32a
12/16/2003	Conv Interview	afterschool	15 - b	32b
12/17/2003	Conv Interview	lunch incl Jim	20 - b	35b
17-Dec	Pocket Rec	classtime - art table - sand inc jim	60 - a	35a
1/5/2004	audio journal	unit 3/art show prep	15 - a	36a
1/5/2004	Conv Interview	afterschool	20 - b	37b
1/5/2004	Conv Interview	lunch interview	20 - a	36a
1/5/2004	Pocket Rec	classtime - art and science table	60 - a	37a
1/7/2004	audio journal	unit 3/art show prep	60 - a	38a
1/7/2004	Pocket Rec	classtime - art and science table	60 - b	36b
1/8/2004	Conv Interview	afterschool	2nd 30 - b	39b
1/8/2004	Conv Interview	lunch	1st 30 - a	39a
1/8/2004	Pocket Rec	classtime	2nd 30 - a	39a
1/8/2004	Pocket Rec	classtime	1st 30 - b	39b
1/12/2004	Conv Interview	afterschool	20 - b	40b
1/12/2004	Conv Interview	lunch	1st 30? - a	40a
1/12/2004	Pocket Rec	classtime	2nd 30 -	40a

			a	
1/13/2004	Conv Interview	lunch	30? - a	41a
1/13/2004	Conv Interview	margot conv - incl end of sci class	30? - b	41b
1/13/2004	Pocket Rec	classtime	30 - a	41a
1/13/2004	Pocket Rec	classtime	30 - b	41b
1/14/2004	Interview-db	sci ed debriefing - Butler	40 - b	38b
1/14/2004	Conv Interview	afterschool - lunch?	20 - b	42b
1/14/2004	Pocket Rec	classtime - art and science table	60 - a	42a
1/15/2004	audio journal	unit 3/art show prep	10 - b	38b
1/16/2004	Pocket Rec	art reception part 2	50 - b	27b
1/16/2004	Pocket Rec	art show recept - part 1	60 - b	8b
Jan-04	audio journal	post-unit 3data collection	?	43a