A Journey Of Teaching And Learning In Science Education: The Microculture Of Emerging Inquiry-based Science Instruction In An Urban, Low Socioeconomic Elementary School Science Lab

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A JOURNEY OF TEACHING AND LEARNING IN SCIENCE EDUCATION: THE MICROCULTURE OF EMERGING INQUIRY-BASED SCIENCE INSTRUCTION IN AN URBAN, LOW SOCIOECONOMIC ELEMENTARY SCHOOL SCIENCE LAB

by

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Education in the Department of Educational Studies in the College of Education at the University of Central Florida Orlando, Florida

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ABSTRACT

This ethnographic study of emerging inquiry-based science instruction in an urban, low socioeconomic elementary school science lab was designed to gain insight into the perspectives of the teacher and students. The study involved a Central Florida elementary school whose population was over 80 percent African-American. In this six month study, the researcher examined the classroom setting of a science lab teacher and her fourth and fifth grade students during a six month period of time.

Data sources included interviews, field notes, reflections, and student work, which were used to identify the emerging themes and patterns in the study. The emergent themes were grouped into two categories: the perspective of the teacher and students in the inquiry environment and the microculture of the teacher and students in that environment. The teacher’s perspectives on instructional strategies, standard based instructional guidelines, and the realities of teaching in an urban low socioeconomic setting were the major emergent themes. The students’ perspectives into environment and sense-making of elementary school students were the other major emergent themes.

Chapter I provides background and the significance of the study. Chapter II provides a research of the literature surrounding inquiry-based instruction in science education. Chapter III describes the methodology, specifically the ethnographic approach to this study.

A metaphoric journey down the river of perspectives in science lab classroom sets the tone for Chapter IV. This chapter provides a “view from the shore,” an introduction to the general background of the elementary school. Chapter V explores the teacher perspectives, and
uses vignettes to analyze instructional strategies, questioning, assessment, standards state and
district guideline and the realities of teaching. Chapter VI discusses the student perspectives, and
uses vignettes to analyze behaviors and actions, responsibility of learners, assessment, and ways
of knowing. Chapter VII pulls together conclusions, implications, and recommendations for
further research.

This study contributes to the total body of research of science education in two ways:

1. It provides student and teacher perspectives on science in an urban, low
   socioeconomic elementary school.

2. It provides research with a teacher and student perspective of inquiry-based science
   instruction.
To: Mom – The World’s Best Mother
ACKNOWLEDGMENTS

“I’ve had good days and bad days, and goin’ half mad days . . .”
Jimmy Buffett (1985)

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CHAPTER I
INTRODUCTION

Change is a journey. Anonymous

The *National Science Education Standards* (National Research Council, 1996) define inquiry as the various approaches to studying and learning science in the natural world. Inquiry is described as a way for learners to plan and investigate their understanding of scientific ideas. A general definition of inquiry in science teaching and learning is a way of making sense or understanding questions and experiences.

The *National Science Education Standards (NSES)* were established in 1996 and include a set of teaching recommendations called the Science Teaching Standards (SES). The context of the *NSES* and SES provide guidelines for teaching science in an effective and active way. The SES provide a platform for teachers to align their teaching practices so that they can fulfill the overall vision of the *NSES*. The vision of the *NSES* is that science should be for all learners, be active and engaging, support science literacy, and be part of overall educational reform (NRC, 1996).

The skills developed from student experiencing inquiry-based science instruction are important in other occupations. Business management books and programs call for workers that are well-rounded problem solvers (Bennis & Thomas, 2002; Fullan, 2001; Schlechty, 1990). Work situations today demand that employees find solutions to questions that arise each day in the work place. For workers or students to be successful, they must have the capacity to
conceptualize change, solve problems, and create solutions. They must be able to understand a problematic situation, work with others to solve the dilemma, and learn from the process of creating a solution using their own experiences and research. Inquiry-based teaching facilitates the process of learning and is applicable to the workplace.

Students learn how to solve problems and create solutions by experiencing them in real and meaningful encounters. If these learning experiences are not provided, resulting in problem-solving capabilities and solution construction may not occur. In seventeen years, Kindergarteners may graduate from a four year college. The jobs that will be available to kindergarteners in the year 2020 may not yet be known. If this is the case, they must have the capacity to conceptualize change, solve problems and create solutions.

Statement of the Purpose

The purpose of this research was to study the perspectives of inquiry-based science instruction in an urban, low socioeconomic elementary science lab. Inquiry-based science is an instructional method which provides students with diverse ways of making sense of and understanding science in the natural world. An essential element of inquiry-based science teaching and learning is the variety of experiences all learners bring to the classroom.

In a case study, Briscoe and Wells (2002) indicate the need for teacher reflection and analysis on their practice and the impact it has on the role of the teacher in classroom practices. The study made the following assertions: change provides opportunities for true reflection, and by doing a self-study research project the teacher plays a major role in their professional development. Other studies indicate similar needs with regard to the investigation of teacher construction of knowledge and examination of teaching and learning processes in science.
education settings (Crawford, Kelly & Brown, 2000; Luft, 1999). Most research states that there is a need to address issues regarding teacher responsibility for allowing students to create and pursue their questions, to provide an atmosphere of collaboration as a community of science learners, and to research and investigate relevant problems, topics, and issues based upon student knowledge, skill, and experiences (Ash & Klein, 2000; Duckworth, 2001).

This research proposed to understand the microculture of inquiry-based science instruction in an urban, low socioeconomic elementary science lab school. The questions that guided this research were:

What is the microculture of inquiry-based instruction in an urban, low socioeconomic elementary science lab classroom?

- What is the perspective of the teacher in the science lab?
- What is the perspective of the student in the science lab?

Background and Significance


Student understanding and communicating scientific ideas are underlying concepts supported by the NSES through the use of inquiry-based teaching and learning (NRC, 1996).
Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating results (NRC, 1996, p. 23).

Learning is a social experience. Science, as a participatory experience, requires socialization. Socialization, through dialogue and events, should occur between all parties in the classroom. A textbook-driven curriculum does not utilize or embrace socialization as part of the learning experience (Barab & Hay, 2001). Students’ concept attainment and knowledge growth solely through textbooks along with unguided, isolated activities was far less than with participatory, inquiry-based experiences (Palincsar, Collins & Marano, 2000).

Luft (2001) suggests that teachers who explore their understanding and beliefs about inquiry-based science education are in a better position to assist in the planning and implementation of appropriate levels of instruction and learning styles. In a research, Luft (1999) suggests that opportunities be provided to teachers so that they can process their understanding of inquiry and translated it into inquiry-based learning experiences for their students. Another study (van Zee, Iwasyk, Kurose, Simpson, & Wild, 2001) suggests that the intentions and pedagogical skills of a classroom teacher can be enriched through insight and reflection. Research supports that an authentic way of learning is reflected in inquiry-based experiences and projects for teachers and students (Schwartz & Lederman, 2002).
Preliminary Study

Groundwork for this study was established in the fall of 2002 after two teachers from one school had completed a 30-hour professional development workshop in science. Pat Brown¹, the science lab teacher and students in this study were participants in a previous professional development project, Mathematics and Science Professional Development (MSPD) at the University of Central Florida during the years 2000-2003. During the MSPD Project, this researcher provided professional development support to the teacher and students, which provided a focus for the present research study. This researcher worked with the science lab teacher and students two or three days a week from January 2003 until May 2003. The work in the science lab consisted of observations of teacher’s classroom practices. The classroom practices were based upon experiences modeled for participants during a summer workshops. The classroom practices included instructional strategies, such as cooperative learning and questioning strategies. Weekly visits with the science lab teacher lead to further collaboration. The science lab teacher and this researcher processed the content and context of the lessons. It was during the processing of the content and context of the lesson that the science lab teacher asked the question, “How can I do it better?” Preliminary examination led to further discussion of inquiry-based science teaching and learning in the science lab classroom.

Pat’s experiences in a variety of activities during a summer professional development workshop in science prompted her to question her instructional strategy. The guided inquiry learning she experienced during the summer workshops were implemented verbatim into her science lab classroom. The teacher questioned her teaching practices and whether the lessons were meaningful for her students. She believed that the lessons were contrived and conventional.

¹ Pseudonyms were used for the teachers and students respecting their individual gender and ethnicity.
She observed that the students participated, but they did not absorb the essence of the inquiry process. The desire to explore and find out more about that topic was not present with her students. Students followed the steps of the activity, but did not experience the authenticity of inquiry. Students came up with “correct answers” or were told to try it again until they “saw” the right answer. Pat was concerned about the disconnect between the higher level of thinking she had experienced during the summer workshop and what was happening in her science lab. How could lessons be planned and taught with an inquiry-based approach? After much discussion about moving science lessons from a traditional hands-on activity to more authentic, student-generated inquiry, the science lab teacher and researcher both agreed that this transformation to the instructional method would require thought for the following school year, while being mindful of the students’ previous experiences.

Definition of terms

Inquiry-Based Science - “Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating results” (NRC, 1996, p.23).

Learning Experiences – Learning experiences can be categorized as skills, observations, activities, lessons or other learning strategies in the science lab.

Teacher Facilitation – Teaching in a way that guides or orchestrates students through learning, rather than teaching as telling(NRC, 1996).
Community Building – The inclusion strategy is fashioned around the idea of establishing a feeling of unity and involvement with a group. It supports an atmosphere that provides trust, a feeling of belonging to a group that cares, and a chance to model affirming and diverse thinking through cooperation and collaboration (Kagan, 1994).

Learning Environment – The learning environment is made up of the classroom (the physical environment), the curricular environment (the content), and the attitude of all involved parties (the affective approach) (NRC, 1996).

Constructivism – Learning is built on the learning and thinking of a human being. It is active and centers on the human’s production of knowledge (Gredler, 2001; Mintzes & Wandersee, 1998; Ornstein & Hunkins, 1998).

Social Construction- Knowledge is a social product. Learning is created using a language system. This system uses discussion and processing as a way to make meaning of events (Lemke, 1990).

Culture- The knowledge, beliefs, norms, attitudes, and values shared by a group of people (Dunn & Goodnight, 2003).

Microculture- Microculture is associated with subculture because the group encompasses smaller groups with shared behaviors, values, attitudes, and artifacts (Lenkeit, 2001).

Perspectives – The perceptions in a culture that assist in the way meaning is assigned to reasoning (Dunn & Goodnight, 2003).

Science Learning Culture- Science teaching should reflect higher-order thinking skills of scientific processes and concepts. The culture of the classroom included actively constructing questions, designing problems, gathering data, and presenting conclusions (NRC, 1996).
Ethnographic Study – Ethnography is a way of seeing or understanding, while narrative ethnography is story-like. It describes and interprets the culture of the organization or structure (Wolcott, 1999; Wolcott, 2001).

Validity/Trustworthiness- Hammersley states that there are two main essentials to qualitative research with regard to validity/trustworthiness, they are plausibility and creditability (Smith & Deemer, 2000). Plausibility of the research means is it reasonable or believable, while credible meaning is the research convincing.

Triangulation- The use of multiple sources of data used to analyze data and patterns or themes emerge from the data (Mills, 2003).

Crystallization- Crystallization is similar to triangulation, it is a process of understanding more about the topic, while using few sources of data (Janesick, 2000).

Limitations

1. The design of this study was limited to the investigation of an elementary science lab classroom.

2. The students and teacher participating in this study could leave the study at any time.

3. The science content presented in the study was selected by the classroom teacher.

4. The analysis of data were interpreted by the researcher.

Assumptions

1. It is assumed that respondents (teacher, students, and researcher) would provide honest and sincere responses.

2. It is assumed that the data would be truthful and ethically obtained.
Design of the Study

This qualitative research focuses on the entire picture rather than an individual aspect of a phenomenon. The holistic approach to qualitative research allows the reader to develop an “insider’s view” of the detailed involvement in the research in its entirety (Ary, Jacobs & Razavieh, 2001; Creswell, 1998; Wolcott, 2001). The research in this study was designed to investigate the naturally occurring events and behaviors in a science lab. This type of research was an authentic way to describe the culture of the teaching and learning of science in a science lab in an urban, low socioeconomic elementary school. The study attempted to identify and analyze the perspectives of inquiry learning and teaching in the science lab. Interviews, field notes, reflections, and student work were used to determine and illustrate the emerging themes and patterns in this study.

This chapter provided a partial preview of the next six chapters. Chapter II offers a foundation for the study in the review of literature discussing theory, inquiry-based instructions, the microculture of teaching and learning, and ethnography. In Chapter III, the focus is on the methodology of the study, expanding upon items disclosed in this chapter.

Chapter IV starts the metaphoric journey down the river of teaching and learning and the microculture in the classroom. This chapter gives you a “view from the shore”, an introduction to the general culture of the school involved in the study. Chapter V will discuss the teacher perspectives, using vignettes to analyze instructional strategies, questioning, assessment, standards- state and district guideline, and the realities of teaching. Chapter VI will discuss the student perspectives, using vignettes to analyze behaviors and actions, responsibility of the
learner, assessment, and ways of making sense. Finally, Chapter VII will pull together conclusions, implications, and recommendations for further research.

Please join me on this learning journey.
CHAPTER II

LITERATURE REVIEW

Although there is research to support inquiry-based teaching and learning (Crawford et al., 2000; Luft, 1999), there is little evidence showing that teachers are interested in learning more about the factors that influence inquiry-based science instruction. In particular, insufficient research describes inquiry-based instruction in urban, low socioeconomic educational settings. There is very little evidence to support that teacher practices are changing (Keys and Bryan, 2001), although some research sources support promising practices such as inquiry-based science instruction. The complex nature of teaching requires much more investigation into practice particularly in urban and low socioeconomic school settings.

This chapter will serve to inform the reader of the literature surrounding the theoretical foundations of inquiry, inquiry in teaching and learning, the culture of education, the culture of teaching and learning, and finally framing an ethnographic study.

Theoretical Foundation of Inquiry

Constructivism do plays a significant role in connecting theoretical learning to inquiry-based instruction. Constructivism is defined as actively engaging the learner in the process of learning or the human construction of knowledge. Social constructionists believe that the role of the learner is to participate in the learning environment. The learner actively constructs knowledge that connects to the learners’ existing knowledge (Gredler, 2001).
Based upon the influences from Vygotsky’s cognitive-development learning theory and Dewey’s educational philosophy, inquiry-based instruction is a hybrid of teaching and learning. Vygotsky believed that levels of development played a considerable role in the advance of higher mental functions. Dewey held that a community of learners participated in the created new knowledge (Gredler, 2001).

Language is achieved through culture. Culture is defined as knowledge, beliefs, norms, attitudes, and values shared by a group of people (Dunn & Goodnight, 2003). Culture and language play a significant role in the cognitive development of children. The learning of language or the use of signs and symbols within a culture occurs by way of social interaction. Vygotsky’s believed that cognitive development involved mastery of symbols in the culture. Vygotsky believed that there was a strong connection between thought and language. This connection was necessary for intellectual development (Gredler, 2001).

Vygotsky’s Zone of Proximal Development (ZPD) is defined as the disparity between potential development and the actual development of the learner (Driscoll, 1994). He also states, “learning awakens a variety of developmental processes that are able to operate only when the child is interacting with people in his environment and in cooperation with his peers” (Vygotsky, 1978, p. 90). The facilitator of learning inquires into the learner’s needs and level of development. By offering the learner direction and support, it allows the learner to realize the learning goals of the environment beyond where they started. “Watching, listening, writing, reading, talking, replaying, and wondering about what is happening prepares the way for inquiry” (Saul, Reardon, Pearce, Dieckman & Neutze 2002, p.18). Young children at play are in the beginning stages of development, yet are on a journey of building potentially new knowledge, therefore Vygotsky would state that they are in the ZPD or the “zone”.

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Dewey’s position was that learning occurs through social construction and varied experiences, in other words, when the learning is focused on the learner. Social constructs, in Dewey’s opinion, are the cornerstone of humanity. Social construction is produced through interacting with the learning environment, forming thoughts, elaborating ideas, and testing ideas. Without society, there would be no communication or interaction of ideas, hopes, or opinions, thus education would be ineffective. The connection between education and communication is essential (Dewey, 1916; Lemke, 1990). In addition, experiences are the foundation for furthering learning and knowledge creation (Ornstein & Hunkins, 1998).

Making a case for social interaction, Dewey (1916) suggests that teachers ground their educational practices in students’ needs and capabilities, not just the subject matter. Learners need an atmosphere that provides a foundation; this foundation can identify their needs and capabilities. Dewey said:

Curiosity is but the tendency to make these conditions perceptible. It is the business of educators to supply an environment so that this reaching out of an experience may be fruitfully rewarded and kept continuously active (1916, p. 209).

Once a teacher identifies the requirements of the learner, the teacher can create an atmosphere of reflection and critical thinking that promotes dialogue and exploration for the learners. Dewey (1910) describes two essential elements in reflective thinking; the need to create uncertainty or doubt and the conscious effort to investigate. Solitary reflective thinking does not support the social construction of new knowledge. The social environment in which the reflective dialogue and exploration takes place is imperative for verification of thought and the next step toward making meaning of the experience.
Dewey (1916) supported inquiry-based instruction. Through the application of social construction of knowledge and experience the learner can stretch beyond where they are in a learning stage and the desire to learn in a social setting to make meaning in situations are all characteristics of inquiry-based instruction.

Inquiry - Learning and Teaching

Learners who examine and explore new ideas can formulate meaningful questions and devise methods to answer questions, provided there is an atmosphere that fosters learning. Inquiry also encourages critical thinking skills, which assist with independent learning (Duckworth, 1987; van Zee, 2000). The National Science Education Standards address the issue of giving learners a voice in decisions about the content of the work. Requiring responsibility for all members in the group or classroom is important. By developing a sense of purpose or relevance in a task, the learner will probe into topics that interest the content (NRC, 1996).

Students should perceive themselves as a community of science learners (Duckworth, 1987; NRC, 1996). The development of science, both process and content, is reliant on sharing and discussing ideas. Inquiry should be viewed as social learning process, where communication leads to the development of understanding and learning science. Learners must see science as a collaborative endeavor that is dependent on the sharing and debating of issues and ideas (NRC, 2000).

Providing opportunities for collaboration with other learners is an important component in the inquiry-based science. Collaboration with other learners allows the student to make meaning of their investigations and prior experiences. It gives all learners an opportunity to check for self-understanding. The struggle to make meaning gives learners and their peers
openings that may lead to further questions or challenges. Teachers facilitating collaboration support students’ ability to build and share ideas and new knowledge. (Hogan & Corey, 2001; Wallace, Krajcik & Soloway, 1996).

Teachers who narrow or focus classroom discussions help students to formulate questions. Some learners draw upon their past experiences in a useful and productive manner. Learners may request tools or resources based on their past knowledge or experiences (Barclay, 1987; Duckworth, 2001).

A case study (van Zee, et al., 2001) with the purpose of examining student-generated inquiry discussions found that using the process of inquiry to learn about science allows learners’ background knowledge, experiences, and skills to influence how the learner thinks and makes sense of new knowledge. Building new meaning occurs when previous knowledge, experiences, and skills meet with new knowledge, experiences, and skills. The new meaning may cause dissonance in the learners’ thinking and learning, or they may see the connections between old ways and the new ways. Learners create conceptual barriers because they are reluctant to let go of their old beliefs about concepts in science. Learners can find new ways to make the old beliefs fit into the current understanding. Teachers can facilitate learning situations so that the learner explore and test their misconceptions. Learners need an opportunity to test the limits of their beliefs and questions, leading to meaningful answers to the questions, confirm or rethink their beliefs (van Zee, et al., 2001).

Pearce (1999) asserts that learners are naturally full of questions, but have been stifled in the current educational system. Learners have been conditioned through their schooling years to wait for the teacher to give them questions, which will in turn lead the learner to the “right” answer. By modifying and enhancing student learning, teachers can slowly transition from
teacher directed activities to guided inquiry-based learning experiences. Starting with given problems, procedures, and answers may need to be established in order for the teachers to ascertain the students’ prior knowledge. Clarifying what the learners know by replacing it with new knowledge or information is a difficult transition for students. Accepting that learning is about the journey, and not the destination, is troublesome for the learner or teacher (Duckworth, 1987). Students can be easily upset with “wrong” questions. They may not have been encouraged to question their thinking; therefore, they do not have questions to further the dialogue or investigation. Inquiry learning must be personally driven. The concern for content and process must be linked with asking good questions and previous knowledge (van Zee, et al., 2001).

When appropriate, the learning can move to an open problem, procedure, and solution or student-centered inquiry-based learning experience. Learners need to be allowed to figure out procedures on their own, if they are to create new experiences and learning events. Palincsar et al. (2000) conducted a study on engaging students with learning disabilities in guided inquiry-based instruction found that if guidelines and strategies are not established at the beginning, students will be confused, the learner will not know what data to collect, or what is relevant to the problem they are investigating. A series of events that lead from teacher directed to learner directed events are essential for successful inquiry-based learning and teaching (NRC, 1996).

Leading learners to question into their own thinking, or promoting new thinking patterns, can cause them to want to discover more. By focusing on their predictions, teachers are able to determine what learners are thinking, as it relates to the content or process. The learners can concentrate on the predictions they thought would happen, not on what was supposed to happen.
The ability to question gives the learner a scaffold to examine more than just the surface (van Zee et al., 2001).

Colburn, a teacher/researcher used the Internet as a vehicle for his students (1998). When students in his classroom are given choice and opportunity, it supports the notion that students are capable of learning. Experience with the Internet, provided another way for students to contribute to their learning. Through empowering the student to examine into their own questions by designing learning experiences, their questions allow the student to follow through with their own ideas.

Teachers working with learners can gradually modify the activities and investigations toward the inquiry-based process. The teacher can target learning toward an inquiry-based process by allowing the learners to understand for themselves procedures, designing the data table to display results, or permit the procedures to be revised or repeated. Inquiry-based instruction leads to more independent thinking, higher-level thinking, and greater expectations on the learners’ part (NRC, 1996).

Culture and Education

Culture is knowledge, beliefs, norms, attitudes, and values shared by a group of people. The concept of culture is a way of exploring human actions across human groups (Dunn & Goodnight, 2003).

Wolcott offers cultural orientation as a way to assist in identifying boundaries (1999). Some examples of boundaries might include place, situations, or time. “Culture offers one way – a conceptual way – to organize disparate observations into a cohesive whole and to convey to others what we have seen” (Wolcott, 1999, p. 254).
The influence of intangibles, such as rituals or principles, helps to define the patterns in the culture. Wilcox says these influences cultivate a better understanding of schooling (1988). School is a social institution and it is the transmitter of a culture. An attribute of this culture is to make certain that student learn a satisfactory amount of skills and behaviors so that they can become contributing adults in the work world. The expectations made by adults may not match the outcomes. “In short, the school is a social institution upon which the culture places highly contradicting expectations” (Wilcox, 1988, p. 271).

Identifying the perspectives within a culture is a way to assign meaning to stimuli or situations. After meaning is assigned to the situation within the context of the culture, the situation is organized and evaluated. The process of perceiving determines what we pay attention to, how we find patterns, and then how we make sense of the situation (Dunn & Goodnight, 2003).

There is an increasing body of research dealing with the practice of conceptual development and attainment in socioeconomically diverse settings. Diverse populations can be defined as culturally, linguistically, or socioeconomically different populations. As the population changes, so do the challenges faced by most in education. Cahnmann and Remillard (2002) found that elementary school teachers in an urban bilingual-bicultural setting had their teaching practice challenged. Diverse populations can be defined as culturally, linguistically, or socioeconomically different populations. Teachers in the classroom needed support to meet the growing needs of the varying population in their learning communities. Teachers needed assistance with identifying differences and integrating both content and pedagogical practices into their teaching. The study concluded that substantial support through professional development.
Zhou (2003) used demographic data from the 2000 Census to identify challenges in educating culturally diverse children in four neighborhoods of Los Angeles, CA. This study confirmed the need for identifying challenges and indicated a need for identifying resources in teaching diverse populations. The study concluded that resources within the community influenced educational experiences of culturally diverse children. The community at large can play a decisive role in influencing and supporting children. Resources such as churches, after-school programs, as well as businesses and organizations can assist in meeting the educational needs of children.

Culture of Science Teaching and Learning

Science education does not look or sound much different than it did in 1985 when the American Association for the Advancement of Science (AAAS) started work on the document *Science for All Americans (SFAA)*. The document, *SFAA*, was produced by Project 2061, an initiative examining educational reform for grades K-12 in science, mathematics, and technology. AAAS (1989) contends that:

“For its part, science education . . . should help students to develop the understandings and habits of mind they need to become compassionate human beings able to think for themselves and to face life head on” (p. xiii).

*SFAA* (AAAS, 1989) addresses effective learning and teaching practices. While the document maintains it is not the definitive piece of writing on learning and teaching, it does support the principles as necessary components for effective science learning and teaching. Some of the principles for learning include:

- Teach for understanding
• Access prior knowledge
• Develop learning experiences from concrete to abstract
• Model and practice scientific skills
• Elicit feedback from students
• Make learning challenging but attainable

The National Science Education Standards [NSES] (1996) also provided a set of standards for science teaching. These teaching standards support the SFAA. There are additional standards in NSES, they include:

• Plan inquiry-based science lessons
• Facilitate student learning
• Assess student learning
• Develop a community of science learners

Today, science education in public schools revolves around the use of textbooks and a lecture format. Many teachers use the textbook as a source for curriculum and instruction.

Barab and Hay (2001) described how a group of middle school students participated in a 2-week long science camp engaged in “real world” science and research. During the study, the researchers found that taking isolated activities and developing the content in a concept building manner provided deeper and meaningful learning experience for the students.

Rop (2002) studied high school chemistry teachers’ perspectives on student-generated questions and investigations. The study found that the examination of student questions were a diagnostic tool and provided that context for further classroom discussions. One chemistry teacher noted a shortcoming of this instructional strategy: student questions challenged the efficiency of the lesson.
Moving from isolated textbook driven curriculum and instruction to student guided inquiry-based instruction is the goal of the NSES and SFAA. Teachers are in search of meaningful learning experiences rather than unconnected activities for their learners (Kelly et al., 2000). Incorporating and applying the standards of best teaching and learning practices from NSES (NRC, 1996) and AAAS (1989) is supported by studies carried out in science education (Barab & Hay, 2001; Rop, 2002).

Science educators need to have specialized knowledge necessary for the content they communicate. While effective learning goals are stated in standards driven curriculum, teachers of science education must be mindful of prior knowledge, developmentally appropriate, yet challenging content (Loucks-Horsley, Hewson, Love & Stiles, 1998).

Bianchini and Colburn (2000) investigated Colburn’s use of inquiry to teach the nature of science with prospective elementary school teachers. The research focused on a teacher’s ability to utilize inquiry to teach the nature of science. The study suggested that the nature of science be used as the content for the context of teaching inquiry-based science instruction. During their study with prospective elementary school teachers, the researchers asked the question “how can teachers use inquiry to teach the nature of science on (Bianchini and Colburn, 2000, p. 180).” Colburn, the teacher as researcher in the group, focused on a conceptual framework relating the nature of science. The six main concepts were:

1. There was no right way to solve a problem
2. Similar science experiences can be perceived differently
3. Evidence of understanding should be provided rather than an assumption
4. Provide evidence does not mean that a conclusion is true
5. A community of scientists should communicates with each other
6. A community of scientists should share their results as a valued process

Neglecting certain aspects of the nature of science in the process of inquiry-based instruction can reinforce misconceptions. The benefits as well as limits of the study were influenced by the teacher researcher’s approach and prior experiences with inquiry-based instruction (Bianchini & Colburn, 2000).

Teaching in a Culture of Change

While moving from the industrial age to the information age, the culture of teaching has changed very little over time. Education continues to use the same conceptual framework for learning and teaching that was used in the 1900s (Keating, 2000). This idea that the process of education gently reminds us of the saying: if we keep doing things the same way, we cannot expect new results. In a culture of change, a few essential components must be identified. A sense of purpose, along with high expectations and an expectation of achievement from teachers and students are all critical to substantive change (Barber, 2000). A core value in the culture of teaching is time. We all have it, we all need more of it, and we all know its value. How is it that we expect change to take place but do not take time to implement it?

Commitment and contribution to the process of change requires not only time, but also leadership from teachers. The teacher or agent of change requires developing relationships that nurtures change, understands change, and adapts to change in a nontraditional way. Once these steps are taken, then change can move forward toward meaningful sustainable change in learning and teaching (Fullan, 2001).

Through the examination of perceptions and beliefs, patterns of change can be recognized and reflected upon (Koba, Clarke & Mitchell 2000). The process of focusing on problems,
collecting data, reporting results and planning actions, lead to continued feedback from teachers involved in the study. The actions plan developed and implemented by the teachers as part of the action research study lead to more feedback and further investigation into teacher change within the school district. In order for this type of change to occur, time and purpose must be allowed. Fullan reminds us that “Change is everywhere, progress is not” (1991, p.345).

Framing an Ethnographic Study

Qualitative research is the study of a phenomenon in its natural setting. Ethnographic research is a form of qualitative research. The holistic approach of ethnographic research allows the reader to develop an “insider’s view” of the detail and involvement in the research in its natural setting or culture (Agar, 1996, 1980; Ary et al., 2001; Creswell, 1998; Wolcott, 2001).

Glesne (1999) refers to the qualitative researcher as “a translator of culture” (p 156). The researcher describes behaviors and events in a narrative form through their own individual lens. The role of the researcher is to richly and authentically illustrate the story of the data as it unfolds (Agar, 1996, 1980; Glesne, 1999; Rubin & Rubin, 1995; Wolcott, 2001). Although the researcher maybe an outsider, he/she still influences the activities and events in the situation. Agar (1996, 1980) suggests that ethnographic studies are not

“just about shared knowledge; rather, said about the practice of everyday life, the way those practices are built out of shared knowledge, plus all the other things that are relevant to the moment (p 9).”

Ethnographic studies should not be about stories of travelers around the world, such as Mark Twain’s Following the Equator (1897). In the book, Twain rambles on about his trip around the
world, visiting new cultures, on a steam ship at the turn of the century. Wolcott (1999) suggests that ethnography is a story told from “the native’s point of view” (p. 139).

An ethnographic approach was chosen for this study because telling the story of the culture in an emerging inquiry-based science lab classroom set in an urban, low socioeconomic setting would provide an insider’s view to the culture of the school, teacher, and students.

In an ethnographic study, the processes of collecting data may include participant observations, expanded notes, and field notes. The use of participant observations and field notes indicate the researcher’s participation in the community or culture. Interviews suggest direct involvement with the participants in the research study. These instruments are used to collect data during the study, allowing the researcher to focus on understanding the culture, rather than focusing on the product of raw data.

_Instruments for Collecting Data_

Field notes and participant observation provide the researcher with an emic or “insiders” perspective. This emic perspective allows the researcher to examine beliefs and behaviors within the culture (Fetterman, 1998). By studying the unconventional behaviors or peculiar tendencies of a culture, Wolcott says the researcher can get “to the heart of the matter” (p. 173, 1999).

These tools can be used for reflection, such as storytelling or journaling, or note taking for curriculum and instruction. Self-reflection can be used as a tool for data collection: rereading, reflecting, and providing context for the data. The self-reflective narrative help piece together the whole story, not just bits and pieces of the data. Combining the use of participant observations along with artifact analysis are powerful tools for data analysis. (Connelly & Clandinin, 1988).
Interviews are used to describe a culture in the person’s own words. One form of interview is the topical interview, designed to investigate common experiences among a group of people. Open-ended questions may be used during the interview; these types of questions can lead to uncertainty with regard to the direction of the interview. There are implications to the design of open-ended interview questions. The interviewee must be flexible and willing to explore the direction of the interview, as long as it is within the scope of the context of the interview (Rubin & Rubin, 1995). Initial interviews can be used as reconnaissance (Wolcott, 1999) Subsequent interviews can be used to test emerging themes, seek deeper understanding or clarify early statements (Rubin & Rubin, 1995).

The transcription of the interview should tell the researcher exactly what was said by the interviewer and interviewee. The research must then code the data within the text of the interview. A member check is another form of inter-rater reliability. Inter-rated reliability is the extent to which two or more observers produce similar results when observing a similar situation over a given period of time (Ary et al, 2001). Member checks are used as a verification process with another person to assist in the overall clarification of patterns and themes that surface from the data. Finally, the significant or overarching themes emerge from the researcher’s analyzing the data (Rubin & Rubin, 1995).

The goal of ethnographic research is to see what is happening and record it in an authentic and accurate manner. It is designed to explore, understand, and seek solutions to complex and ever changing situations. In summary, ethnographic research focuses on a story told in a rich, real, and relevant way.
Chapter III will discuss the methodology of the study. In addition to the design of the study there will be an introduction of the science lab teacher and the setting, data collection, and data analysis procedures.
CHAPTER III

METHODOLOGY

“I share this story here because it vividly represents the message of my life: always have a vision, formulate a plan, and lean into it.” Frederic M. Hudson, 2000, p.149

Qualitative research, specifically ethnographic research, focuses on telling the story behind the problem. Eisner (1991) suggests that qualitative research is not a linear process, but rather a process that expands and unfolds as the research moves forward. The researcher in a qualitative study is gently guided by the water they are in at that time. While the researcher cannot control the direction of the water flow, he/she can control what they see and how they document their journey.

This chapter will discuss the design of the study, an introduction of the science lab teacher and her science lab classroom, data collection, and data analysis procedures.

Permission for study

Initial permission to conduct this study was obtained from the elementary school principal. Due to the relationship of the science lab teacher and researcher established prior to the start of this study, the science lab teacher agreed to participate in the study. Permission for this study was granted by the University of Central Florida-Institutional Review Board to conduct a study about the microculture of inquiry-based science instruction in an urban, low socioeconomic elementary school. Written permission was obtained from the principal, science
lab teacher, and students who participated in the study. The study started after permission was received from the Institutional Review Board.

Setting

Sunray Elementary School\(^2\) is a neighborhood school located in a Central Florida metropolitan city. During the time of the study, the old elementary school was being torn down and a new one was being built. The students, faculty and staff of Sunray Elementary School moved to a new, unoccupied elementary school campus, which was the temporary elementary school setting for the students until their new building was completed in the 2004-2005 school year.

The former Sunray Elementary School was very old and in disrepair. There were approximately 20 portable classrooms, and the campus was very spread out. To get from one classroom to another required teachers and students to walk quite a distance from one place to another, often without the benefit of a covered walkway. When inclement weather occurred, students were not allowed to move from building to building. The science lab was located in the outermost corner of the school campus, so there were times that students did not attend the science lab, or the science lab teacher had to travel to the students’ classroom.

The new campus was not part of the neighborhood where the students lived, even though it was only two miles down the road from the original school. It was situated in a more affluent area. Being a brand new school was an asset because it provided many amenities not found at the former elementary school site. Some of the amenities included a completely enclosed corridor arrangement and a state of the art voice enhancement system. The voice enhancement system used the overhead speakers to provide improved voice sound quality for all students in the

\(^2\) A pseudonym was used for the elementary school.
classroom. The teacher wear wireless microphones around their necks or as a hand held microphone.

The elementary school where the study was conducted has a school population of over 600 kindergarteners through fifth grade students. With over 80 percent African-American, approximately 10 percent white Caucasian, six percent Hispanic and four percent other\(^3\) populations this elementary school has a majority minority population.

The school has over 90 percent participation in the free and reduced price lunch program, making it a low socioeconomic school. The school also provides a free and reduced priced breakfast program prior to the beginning of the school day. Free and reduced priced programs require parents/guardian to complete forms indicating financial need for free lunch or reduced prices on lunch for children at school.

*Pat Brown-Science Lab Teacher*

Pat has been teaching for over 25 years at Sunray Elementary School. She has taught everything from kindergarten through fourth grade. Pat’s teaching background is representative of many elementary teachers at Sunray; more than 50 percent of the staff have been at Sunray more than 15 years. Pat has no formal education in science, but has participated in many science workshops and is involved with the local science center.

Pat’s area of certification is general elementary education. She is starting her second year of teaching in the science lab. The goal of the science lab is to provide hands-on experience in science for all students in grades kindergarten through fifth grade. Classroom teachers may or may not provide their students with the daily science activities.

\(^3\) “other” was a racial category stipulated by the district office.
The students attend the science lab on a five day rotation schedule. However, on Wednesdays, classroom teachers have grade level planning all day. Therefore, on Wednesdays Pat had one grade level all day long. Each class is approximately 50 minutes long.

The Science Lab Classroom

This year, Pat’s new room was actually designated as the art room. There was no science lab classroom designed for this school, so the art room was the most appropriate room. Also, the other specialty areas such as the math lab classroom and music were located in the same hallway system.

The science lab classroom is bright with windows facing the south side. It is located in the very front of the school, found to the right of the open stairwell as you walk into Sunray Elementary School. There were large windows that showcase what the teacher and students were doing in the science lab.

The classroom was arranged to facilitate small group work. Each rectangular table had three chairs facing the front of the classroom. There were ten tables to accommodate up to 30 students. On each table had a cup with pencils for each student to use along with their science journal with their name on it.

Around the room were counters containing items that support science, such as an aquarium with tadpoles in various states of development. An indoor butterfly garden had three butterflies and two plants for students to observe.

Part of the daily routine in Pat’s classroom is to rotate out one set of notebooks for the next class set of notebooks. Because Pat teaches all grades, kindergarten through fifth, it requires
her to exchange one class set of notebooks for the next incoming class set of notebooks with each period of the day.

Teaching all grade levels required Pat to transition instructional strategies. Because this was her second year as a science lab teacher, Pat was trying to expand upon experiences from the previous year. With fourth and fifth grade students, she focused more on specific skills and content that may be required in FCAT testing.

The A Plus Educational Plan is a process used by Florida to evaluate schools. It has three main parts, one of which is providing accountability and improving student learning based on a standards driven curriculum. FCAT, Florida's comprehensive achievement test, was implemented in 1998 and is a featured component of the accountability plan. FCAT, a statewide test, is based in the Florida Sunshine State Standards. FCAT testing in writing, reading, mathematics, and now science is considered a valid and reliable test (State of Florida Department of Education, 2002).

Data Collection

The methods of data collection were designed to provide information that would lead to a holistic picture of the microculture of inquiry-based science education in an urban, low socioeconomic elementary school. The data collection took place from August 2003 through January 2004. The tools included in this study were: interviews, participant observations, field notes, reflections/expanded notes, student work, and conversations with Pat.

4 The Florida Department of Education - Florida Comprehensive Assessment Test: FCAT “The primary purpose of the FCAT is to assess student achievement of the high-order cognitive skills represented in the Sunshine State Standards (SSS) in Reading, Writing, Mathematics, and Science. The SSS portion of FCAT is a criterion-referenced test. FCAT Science is administered to all students in Grades 5, 8, and 10 (2003, para. 1). FCAT Science content scores are reported for four areas: 1) Physical and Chemical Sciences; 2) Earth and Space Sciences; 3) Life and Environmental Sciences; and 4) Scientific Thinking.” (2003, para. 10).
The building principal, Pat, and her fourth and fifth grade students were asked to participate in the study. Each class of the fourth and fifth graders were spoken to about their choice to be involved in the study. All participants were asked to complete and sign a consent form prior to the start of the study (Appendix B, G, I). The forms were handed out and the consent forms were explained, then time was given to explain and answer questions to the classroom teacher, students, and Pat (Appendix C).

The classroom teachers needed to understand the nature of the study, because their students were involved in the study. Their support was needed in receiving the consent letters back from the families of students willing to participate in the study. I contacted the fourth grade and fifth grade team leaders, and met with each grade level to explain the nature of my study as well as the procedure for the consent letter. The classroom teachers expressed concern about the readability level of the letter. They suggested that changing my telephone number on the consent letter to the school's telephone number would provide easier access if parents had questions. They also suggested that the consent letters be sent out on the same day for both the fifth and fourth grade. This way if families had students in both grade levels, the families would receive the letters at the same time.

Once the fourth and fifth grade teachers received consent letters and the letters were signed by parents or guardians, the classroom teachers either handed me the letters or placed them in Pat's mailbox in the teacher’s room. I recorded which students would be available for interviewing in the collection of data. Each consent form had the student’s gender, race, and identifying name for purposes of confidentiality during the study.
Interviews

Open-ended questions were used during the interview (Appendix D, E, F, H); these types of questions can lead to further development of ideas and do not limit the interviewee’s responses. Interviews were used to examine emerging themes, seek deeper understanding or to clarify early statements. The interviews were read and re-read several times during the study.

I interviewed Pat in August 2003 with specific questions (Appendix H). Later interviews were informal and usually occurred over lunch during the time of the study. Pat was the first person I interviewed for this study. Students were later selected randomly from eligible consent forms. The researcher obtained written consent from all students, parents/guardians who were willing to participate. There were approximately 250 students in the fourth and fifth grade, all were provided with a parent/guardian consent letter. Each class was separately identified and placed in organization folder. Each class’s consent letter was sorted into voluntary participation or non-participation. Consent letters were sorted by gender; however no effort was made to select students by race. Students were chosen for interviews based upon availability during science lab time. The number of students that participated from each class was determined by the length of the interviews and time available. All the interviews were recorded, transcribed and analyzed for emergent themes and patterns.

During the morning, Pat and I had a ritual of chatting about activities from the day before and what was planned for that day in science lab. I asked her if there was time for us to do the interview. She said “how about now?”, so we sat down and did the interview at a student table before the day started.

Pat was interviewed to gain initial understanding of the planned learning experiences from last year (2002-2003), and what she planned for this year. The interview occurred once at
the beginning of the study and it lasted over 45 minutes. The interview was conversational, yet guided (Appendix H). The questions focused on practices in the science classroom. Pat did not have to answer any questions she did not wish to answer and could withdraw from participation in the study at any time. Her confidentiality was protected throughout the research process. Her identity was coded as Mrs. Pat Brown when the tapes were transcribed, to protect her privacy and maintain confidentiality. I transcribed the tape word for word from the interview.

The student interviews were scheduled for August, November and December 2003. The students’ interviews were prepared to be conversational, yet guided (Rubin & Rubin, 1995). The questions focused on their learning experiences in the science classroom (Appendix D, E, F). The students did not have to answer any questions they did not wish to answer and could withdraw from participation in the study at any time. Their confidentiality was protected throughout the research process. Their identities were coded when the tapes are transcribed, to protect their privacy and maintain confidentiality. I transcribed the tapes word for word from the participants.

The questions for students’ first interview were based upon the nature of science (Appendix D). This focus was chosen because I wanted to gain insight into their perceptions of science and what they did in the science lab classroom. Students chosen to participate in the interview and were individually invited to the media center for an interview during science lab. The atmosphere of the interview was friendly and quiet. I started each interview beginning with an opening monologue stating the purpose of the study and an option for the student to end the interview if they wished. I went over how the tape recorder worked. Using a micro cassette recorder was something many students had not experienced before, so we did a couple of test speeches with the micro cassette recorder. Students were interviewed during each of the fourth
and fifth grade science lab classes. The subsequent interviews (Appendix E, F) were based on lessons taught in the science lab. Each initial interview took about ten to fifteen minutes.

Interviews were only a small part of developing and understanding of the microculture in the science lab. The following section will detail further collection tools.

**Other Sources of Data**

The data gathered during the daily routine of the classroom were documented with field notes. Field notes, a primary recording tool used by qualitative researchers, were collected daily. This daily log of information explained and described classroom routine, activities, and conversations. These notes were used to document emerging ideas or themes (Glesne, 1999). The data were used to corroborate findings in interviews, reflections/expanded notes on the interviews, and student work.

Participant observations are crucial to understanding the microculture of a setting. The detailing of specific items such as the amount of time a teacher talks and the amount of time a student talks reveals a great deal about their perspectives. Each morning prior to the start of the day, I took a piece of notebook paper put a date on it folded it into quarters numbering each quarter and placed it in my pocket.

I call this data collection system my “foldings”. Foldings (Appendix K) were an unobtrusive way to record participant observations and make field notes during class. Through previous experiences, using a clipboard or a laptop detracted from the total experience of observing in the classroom. Students tended to question the use of technology or wanted to look at what was written down on a clipboard. Also, the “foldings” allowed me to carry my work with me at all times.
Information gathered during the daily routine of the science lab was documented with Foldings. Field notes, a primary recording tool used by qualitative researchers, were a daily method of collecting data. The daily log of information explained and described science lab routines, activities, and conversations. The field notes were used to document emerging ideas or themes (Glesne, 1999).

I later used the foldings as a source to create expanded notes. My expanded notes created a reflection process and additional questions I had about some of those experiences. It also provided a platform for me to think about resources and questions to discuss with Pat the following day. By reading and rereading the foldings, I was to see patterns in conversations, which gave me another perspective on what was happening in the science lab. If I noticed that Pat was saying the same things at the beginning of science lab time, I focused my attention on a specific student’s actions.

Expanded notes and reflections were created based on the foldings. The data were reflected upon and analyzed for better understanding of the interrelationship between planning and implementing of inquiry-based science teaching concepts while examining the learning environment. The state standards and district guidelines were used to develop lessons appropriate for each grade level. Students’ prior knowledge was considered, but was not always incorporated into the lesson. I added personal reflections on the teaching practices documented in the study at the end of the week. The reflections indicated personal involvement while participating in the study.

Samples of students’ work were collected as part of the study. The student work was used as evidence of student understanding of science concepts and inquiry-based instruction. Students did not have to provide work if they did not wish. I personally asked each student eligible to
participate in the study if I could make copies of their work from their science journal. Student confidentiality was protected throughout the research process; I used the code on their consent form when documenting student work. I would photocopy the student work, and then Pat and I reviewed students’ work and looked for themes.

Regardless of the schedule or timing of the day, we had lunch together. During this time we discussed family and friends, but also processed morning activities and experiences. These conversations served to de-construct the lesson from the morning, and any adjustments needed for the afternoon. Conversations during lunch were a part of the data collection. Lunch discussions were recorded to accurately document what transpired. I asked Pat to share her thoughts and/or reflections during our lunch conversation as a form of reflection. Barton (1998) suggested this time as a moment to dialogue about teaching, learning, and personal topics.

My reflections indicated my involvement while participating in the study. A member check was made with Pat regarding most experiences in the science lab. These member checks were often informal and impromptu, but noted in my data collection system—foldings (Appendix K). The participating teacher reviewed participant observations, field notes, interviews, and other data collected during the study as part of the member check. These member checks were used to verify understanding of the data.

Data Analysis

This research focused on qualitative analysis of data. In a qualitative study, recurring themes in emerging patterns must overlap from the data collected. Therefore interviews, participant observations, field notes, and student work were used to analyze the emerging themes
and patterns. The data were analyzed through triangulation, a process using multiple sources of data to confirm emerging factors (Yin, 2003).

Triangulation, the use of multiple sources of data used to analyze data, contributes to the validity/trustworthiness of qualitative research. Through the multiple sources of data, patterns or themes emerge. Janesick (2000) and Richardson (2000) offered crystallization as mutually beneficial facet to triangulation which adds rigor to the analysis. Crystallization, similar to triangulation, is a process of understanding more about the topic, while using few sources of data. “Crystallization provides us with a deep, complex, thoroughly partial, understanding of the topic. Paradoxically, we know more and doubt what we know. Ingeniously, we know there is always more to know (Richardson, 2000, p. 934).

The “Long-Table” approach was used to analyze the data (Krueger & Casey, 2000). This approach used printed transcription of data, spread out on a long surface, allowing themes to be coded. The transcribed interviews had a number on each line and each page had a heading denoting the interviews code name. Expanded notes/reflections, and student work was printed with a number on each line and each page had a heading denoting the source and coded source. A color coding system was used to identify reoccurring themes for frequency and specificity.

A member check was made with Pat to review the audio tapes, expanded notes/reflections of interviews, and student works gathered during the study. This process included verbal and written responses. The member checks usually occurred in the morning as Pat prepared for the day.

When I transcribed the audio tapes, I created expanded notes and reflections on the audio taped interviews. Analyzing the data gathered during the interviews gave me understanding of the interrelationship between teaching and learning in an inquiry-based science lab class. It also
gave me the opportunity to examine the learning environment or microculture. The data from the interviews were analyzed continuously throughout the study. The context of the interviews was used to reveal thinking and learning of the fourth and fifth grade students from the beginning, middle, and end of the study. The interviews were transcribed, read, and re-read to synthesize a deep understanding of the data.

After the interviews, I made transcriptions of all interviews and shared them with Pat. A member check is a collaborative process in which the researcher and participant examine data to test out and verify experiences and understandings (Ary et al., 2002). This process allowed us to elaborate and clarify what we thought the students meant during the interview. Subsequent interviews followed the same process and facilitated an understanding of the microculture of inquiry-based science instruction.

Validity and Trustworthiness

Validity and trustworthiness of this study was based upon the techniques detailed in the methodology and organizational design sections. Mills (2003) suggests that the validity comes from the descriptive, interpretive, and evaluative aspects of the data. Mishler states that: “focusing on trustworthiness rather than truth, displaces validation from its traditional location in a presumably objective and neutral reality” (1990, p.420).

The strategies used in this study included:

1. Triangulation or using multiple sources of data to support findings. This study used interviews, participant observations, reflections/expanded notes, student work, and field notes as sources of data for triangulation (Glesne, 1999).
2. Member checks, a form of peer-debriefing, allowed the participating teacher participant observations, field notes, interviews, and other data collected during the study (Glesne, 1999). This process allowed me to make sure that I understand what I think I understand. By receiving more than one perspective on the data that were collected, there was greater assurance in the accuracy of understanding the data that were collected (Mills, 2003).

3. Reflections and expanded notes provided an opportunity to reexamine the data that were collected, and a source for further questions and items to be observed during participant observations and field notes. Reflection also assisted in the clarifying subjectivity and monitoring bias (Glesne, 1999).

4. Extended involvement and continuous observation allowed trust to be developed (Glesne, 1999). Repeated field observations in the classroom were used to identify patterns of behaviors. Being fully present in the classroom each day, and each time they have all day specials allowed me to see the fourth and fifth grade students in their science lab environment.

5. Current research in this field or on this topic are continually investigated to learn more about the microculture of inquiry-based based science instruction in an urban low socioeconomic elementary school.

External validity or the ability to transfer the data from one situation to the next is difficult to do in a qualitative study. Due to the fact that I spent more than 70 days with the fourth and fifth graders in the science lab over a six month period of time should allow for generalization, because of the accumulation of data during the study. The ability to generalize what is uncovered or learned may be applicable to this study alone.
Participants

With approval from the Institutional Review Board (IRB) aspects of the study research minimized risk to the participants: the science lab teacher and students. The IRB document indicated the intentions to protect the science lab teacher and students from any risk related to the study, yet maximize the benefits of the research through new knowledge gained from the study (Appendix A).

In the next chapter, Chapter IV starts the metaphoric down the river of teaching and learning and its microculture in the classroom. This chapter gives you a “view from the shore”, an introduction to the general culture of the school involved in the study.
CHAPTER IV
THE MICROCULTURE- A VIEW FROM THE SHORE

Heraclites, an obscure western philosopher of nature and society, said that we can step into the same river, and yet never the same water. In the river of existence, we never have the same exact opportunity twice. Although we are afforded similar opportunities, a specific opportunity, if not taken at that moment in time, will be lost forever. Teaching with an inquiry-based focus is similar to stepping into the same river, but never the same water. Although the procedures and processes are similar each time, the flow of teaching and understanding differs.

Starting at the Headwaters – An Introduction to the Microculture

Culture is based upon beliefs and norms, and how those beliefs are carried out. The culture of school creates a climate: positive or negative. When walking into a school, one immediately get a sense of what the school is about as a whole. The culture of the school sets the quality for teaching and learning.

Microculture is associated with subculture because the group encompasses smaller groups with shared behaviors, values, attitudes, and artifacts (Lenkeit, 2001). The science lab is a microculture of Sunray Elementary School because they share similar formal procedures. These procedures include the expectation of taking attendance, participating in class work, and behaving in a certain manner in the science lab. The students and teacher have their perspectives on what is valued and how things should be managed in the science lab. Students influence
teacher perceptions and the teacher influences the students’ perceptions. The perceived rituals of the science lab may be different for the teacher and students. The perceptions merge like many small brooks into a larger body of water. Sometimes the incorporation of the two causes a maelstrom effect.

Someone walking into a classroom can quickly get the sense of: What is valued? Who is important in here? Will I be heard? How do I fit in? Who really cares? These questions drive student behaviors and attitudes, which translate into their ability to think and learn.

The Science Lab – A Microculture

Walking into the lobby ahead is a larger main staircase, flanked by two larger classrooms with window opening out to the lobby. The science lab room is positioned at the front of the building, just to the right of the main staircase. Two large sets of windows in the science lab allow anyone walking into the main entrance to observe teaching and learning in the science lab. Pat had one display: a tank with tadpoles or as one student called them “froglets”. The tadpoles were a source of curiosity for children and adults.

Walking into Pat’s classroom, her desk was located in a corner in the front of the science lab. Her desk reflected a lot about her life and values. She had individual pictures of her husband and two children. The picture of her husband was a traditional formal portrait. Pat and her husband celebrated their twenty fifth wedding anniversary during the study. Her daughter’s picture shows Kristy in her high school cheerleading outfit, and her son Charles in his high school baseball uniform. Both children are in college and came home regularly for visits with Pat and her husband. The other picture was taken at Halloween time, with Pat dressed up in one of her son’s old baseball uniforms and the media center paraprofessional dressed up as Raggedy
Anne. Their arms are interlocked and their faces reflect happiness. Other items on her desk include a pillow with a saying about old friendships are good friendships, pens with maple leaves taped to the end, and her grade book opened to a list of alphabetized students’ names. Behind her desk is a computer, with the screen usually opened to the school district’s email account.

The expectation for email was that it should be checked regularly throughout the school day. It was not uncommon for the office staff to announce through the public address system that teachers needed to check their email for a special bulletin or to shut down computers for network updates. Pat, in her effort to remain current with technology, was involved in a technology course offered at the school.

Pat’s classroom was set up in rows with rectangular tables and three chairs at each table. There were two rows of tables with four tables in each row and two tables off to the side to accommodate overflow. The total setting was for thirty students. Each table had a cup with a number on it, which held pencils and erasers for the students to use during science lab. In preparation for the day, there were tubs of materials on the desks. These tubs contained items that would be used during the lesson.

The science lab was designed as an art room, with larger deep cabinets to store art projects. One bank of cabinets was used for storing the students’ science journals and other work, such as posters created as part of their learning in the science lab. There were windows in the back of the room with a long counter and two sinks which looked out into the parking lot area. Plants and objects found in nature, such as specimens preserved in clear plastic boxes, adorned the counter top. Two bookcases on an adjacent wall contained a variety of age appropriate informational books. Many of the books were the result of discards from the library and Pat’s personal accrual over many years of teaching. There was an appropriate amount of
storage in the classroom, with large locking cabinets, a four-drawer filing cabinet, and storage room.

The walls were covered mostly with windows and cabinets, so there was little wall space for display. The wall space that was available for display contained science related pictures and posters. During my time there, the posters were never used as instructional resources, but as decorations.

Also located in the classroom were six computers. The status of the computers’ permanent home was never truly established during my time in Pat’s classroom. During the first week of school, she was told the computer would have Internet and printing capabilities, but three weeks later she was told that the computers would be assigned elsewhere.

Specials Rotation – Scheduling

“Specials”\(^5\) consisted of a six-day rotation of the five classes. Science lab is considered one of the five special classes. Each specials teacher saw the students for 50 minutes, every sixth day, with the exception of Wednesdays. On Wednesday, as a way to support teacher planning within a grade level, one grade level of students was designated to participate in specials all day. These students only had contact with their regular classroom teacher at the end of the day. The students meet in either the specials classroom or the media center for attendance and spent the rest of the day rotating through all five of the specials.

During the study, I saw fourth and fifth grade students once every six days and on their assigned all day specials. By attending the regular six day rotation and the all-day specials, I was able to examine some lessons taught over a period of six days with time to reflect and discuss

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\(^5\) The Specials included science lab, math lab, music, and two physical education programs. Media was one of the specials from the year before. During this study, another PE component was added in lieu of the media special.
lessons with Pat. With the all-day specials I was able to observe Pat teach the lessons, while she analyzed and adapted the lesson for the learners.

Jumping Into the River

I am not in charge of anything. My role is to create mirrors that show the whole what the parts are doing. Pascale, Millemann & Gioja, 2000, p181

I stood at the front door of the new school building, all shiny and clean, with my book bag, new pencils, notebook, tape recorder, and bag lunch. Sitting on the bench with a group of students, I waited for my teacher, Mrs. Brown, to arrive. Eager to start the day, I was nervous. Would I fit it? Would I know what to say? Would I be able to do this? Would I be able to tell a story that was significant, not just to me, but to others? All of these questions swirled around in my head like a water whirl pooling in a stream.

Even though this was my first day, I did not want to hinder the students’ excitement of the first day of school. So, I sat and waited for the rush of students and families entering the doors of the school to pass. I had to remember, this experience was not about my petty insecurities, or me but about the culture of learning in this school.

My background was middle school science education; the elementary school culture was very different. I was comfortable and familiar with behaviors and attitudes of middle school, especially after spending twenty years working in that culture. The uncertainty of jumping into the river left me with a sense of dissonance. Working with elementary school students and being in the culture of an elementary school was unfamiliar territory. Not knowing the norms, I did not know what to expect of them or myself. It was like I was in elementary school for the first time in my life. Agar (1996, 1980) speaks of the culture shock when being immersed in a new culture;
I was just beginning to understand what he meant. This culture was so foreign to me. What was I getting myself into? I remained focused on the fact that this experience was not about me. It was about the teacher and the students.

My teacher, Mrs. Pat Brown, met me in the hallway. I walked into the science lab classroom with Mrs. Brown and was greeted and hugged by a group of girls. Mrs. Brown told them earlier that I would be working with them this year. They remembered me from previous visits and showed their enthusiasm for my arrival. Being a fairly gregarious person, I welcome hugs from family and friends, but this caught me off guard. These students did not know me, and I questioned how they could they hug a stranger. The culture of middle school encourages teachers not to have physical contact with their students. Yet in this culture, these girls ran up, showing their joy and excitement at my presence, and left me quite unnerved. I kept telling myself: “It’s not about you”.

Leaning Into Inquiry

Inquiry is like cooking: you have a basic recipe to work from, but to make a really great dish you have to consider so many things. I love to cook and when friends come over, they will ask for a recipe of a new dish I constructed from my experiences. By watching television, reading books, and experimenting in the kitchen, I have cultivated my skills and tastes. The warning accompanies many of my dishes: If you really like this dish, you will probably never have it like this again, so enjoy!

My understanding of inquiry has changed over the years. The formal definition as stated by the National Science Education Standards (NRC, 1996) defines inquiry as the various approaches to studying and learning science in the natural world. Inquiry is described as a way
for learners to plan and investigate their understanding of scientific ideas. My general definition of inquiry in science teaching and learning is a way of making sense of questions and experiences related to science. The surge that pushed me to make sense was my own personal desire to find answers to my questions: the more I learned the less I knew for sure. I knew that was what drove me, but I also knew that was not what drove others. Untangling my understanding of inquiry was an important step forward in understanding Pat’s perception of inquiry.

My experience working with Pat made me stop and assess my understanding of inquiry. In an interview (August 29, 2003) with Pat, she shared:

“…using the inquiry type method, using questioning, answering and having them figure it out. Not the teacher standing up there and saying this is the answer. Letting them find out, having them come up with the answer. I think that's the best way that they can learn science. Using hands-on activities, using questions and answering. Finding answers to questions. Finding out what they do know before that they actually get into it to. Finding out little things that they don't know, like vocabulary words.”

Pat’s understanding of inquiry was fundamental compared to my understanding. I had more experiences and opportunities to apply inquiry. Her focus was still on the questions she could ask the students, not the questions the students could ask of her to design investigation to further their learning. As she embraced teaching science, she recognized she knew she had a long way to go, yet acknowledged her progress (interview December 1, 2003).

“I have come a long way from the way I used to teach. But I’ve got to tell you, it’s really hard. I have to remember so much. I know I have so much more to learn.”
Pat expressed concern that she “give me good data” for the study. I said that all data were good data, as long as I am honest about the story and honor the teaching and learning that goes on in the classroom. Having worked with Pat over the last two years, I knew she trusted me to provide her with feedback, reflection, and questions in a professional, yet personal manner. She knew I would not do anything to embarrass her in front of her students or her peers. We had developed an unstressed and uncomplicated working relationship with each other; both in and out of the classroom. With Pat’s meaning of inquiry in mind, as well as my perceptions, we both metaphorically held hands and jumped into the river.

Considerations for Analysis of Data

Two impressions came up during the analysis of the data. One was the idea of interviewing and the realities of interviewing. The other impression was the progression of lessons; whole day versus a six day rotation.

While reading through initial interviews, I found I was cutting short responses to interview questions and not opening up the questions for further explanation. Upon the next round of interviews, I used fewer questions, not work so hard to “get an answer”, and just allowed the interview to flow. I stopped trying so hard to get “good data” for the study. Listening to the learners, Pat, or the students guided my line of questioning.

The desire to stay focused on the study almost overwhelmed the process. There was no “right way” to gather or organize data, but I struggled to have it make sense of the process. Taking time to review the data as it came in rather than waiting until the end of the study to analyze the data benefited the process. If the preliminary data analysis was not completed until later in the study, the interviews may not have revealed the patterns that they did.
As I reviewed the body of data, I noticed patterns in lessons taught over a six day rotation and lessons taught sequentially on Wednesdays. The vignettes that were chosen for analysis were selected because the lessons taught in succession in one day revealed the pattern of adjusting the lesson “on the fly”. The lesson taught over a six day rotation revealed daily adjustments with new resources and incorporation of new thoughts based on discussions between Pat and I.

Glesne (1999) discussed the way Wolcott made connections of data to themes through description, analysis, and interpretation. The description, as described by Wolcott (2001) is the story, the analysis as identifying the key factors derived from patterns and interpretation as the extension of the analysis and connection to alternative means of presenting the data. Wolcott states that the story should be separate from the analysis and interpretation. "Once the descriptive account is firmly in place, I suggest you proceed with analysis in a manner that keeps it distinguished from the descriptive material" (p35-35, 2001). He goes on to assert that frequent headings should be used to guide the reader along. This format will be used to guide the reader through the two chapters of data analysis.

I invite you on a journey down the river of the emerging perspectives on inquiry-based based instruction. Chapter V discusses the teacher perspectives which focused instructional strategies, the state and district standards, and the realities and experiences of the science lab teacher. Chapter VI discusses the student perspectives which focused on students’ beliefs and behaviors, and the students’ ways of making sense of their learning experiences. Following the description of the data, there will be a discussion of significant points connecting current research to themes or patterns.
CHAPTER V

TEACHER PERSPECTIVES

The challenge for the teacher is to constantly ensure that worksheet, textbook, and other activities allow or lead into thinking about the possible as well as the actual. Egan, 1992, p.49

Before starting with the analysis of the teacher perspectives, it is necessary to explain how the specific vignettes were chosen. Two major concepts transpired during the study: matter and magnets. Each concept had three lessons associated with it. Each lesson described was presented to all fourth and fifth graders. After reviewing the field notes and looking for patterns, the two lessons on matter and magnets that were the most representative of introductory lessons. These lessons were selected as the vignettes. The introductory lessons represented the beginning stages of inquiry-based instruction. Each lesson was influenced by the previously taught lesson and, each time, Pat grew more comfortable anticipating students’ questions and answers. Her content knowledge and pedagogical abilities were modified as she gained confidence with each lesson.

The following accounts offer broad-spectrum insights into the perspectives of this classroom. The vignettes detail instructional strategies, questioning, assessment, realities of teaching, and life experiences. Each description is followed by a discussion, interwoven with relevant research.
Matter and Its Properties

The fourth grade classroom teacher and Mrs. Brown chatted as the students filed into the science lab. The students took their assigned seats and each found their notebook from a stack at the end of their table. Some students rapped pencils on tables, while others turned around and talked. I started to write down my observations.

Mrs. Brown: “Get out your science journals and write the questions from the board, while I take attendance. Boys and girls, you know what you need to do.” Mrs. Brown went through and called each student’s name from the roll book, with her back to the students. Even though the students had been coming to the science lab over a three month period, Mrs. Brown still struggled with names and pronunciations. She only saw the students once every six days, so continuity of students and names remained an issue. Students replied “here”, while others called out with updates regarding the current status of a student not present in the science lab.

“He’s in ISS again”, one student called out.

“No he ain’t, he’s wit’ Mrs. Gonzalez talkin’ wit’ her in her room,” shouted another student.

The whole class shared what they thought had happened to student. The noise level rose and Mrs. Brown could not finish taking attendance.

“Alright class, let’s sit up straight and tall. That’s enough. We can’t do today’s activity if you don’t have the questions down. I don’t see many boys and girls with the question written down.” Mrs. Brown quickly scanned the classroom. Some students did not have their science journal open. “Why don’t you have your journal open?”

“Cuz I’m done,” replied Tameka.

“How would I know that if your journal book is closed?” asks Mrs. Brown.
Tameka shrugged her shoulders and opened her journal book. Mrs. Brown went back to finishing attendance.

“OK class, today we are going to answer the question: how do you know whether various changes in matter are chemical or physical? What are some attributes or characteristics of matter?” continued Mrs. Brown.

Mrs. Brown asked students to raise their hands if they knew. Initially, she called on students with their hands raised. Some students were “not paying attention.” They talked with the other students at their table, looked out into the hallway and waved to friends walking by, or “played” with the eraser. When she called on them they looked away, shrugged shoulders, or slouched down in their chair.

“Ok boys and girls; let’s start with the definition of matter. What is the definition of matter?”

Richard waved his hand wildly in the air and shouted out, “Something that takes up space.”

“Can someone give me an example of matter?” Mrs. Brown repeated to the whole class.

“Chairs” called out Chentell.

“Food” shouted Tameka “and furniture.”

“If it takes up space, does it have properties?” questioned Mrs. Brown.

While some students talked with each other at their tables, others tapped pencils on the table and looked around. Mrs. Brown posed the question to the whole class again: “If it takes up space, does it have properties?” Still the students were unable to respond to the question.

“Ok, what are the properties of this table?” Mrs. Brown posed to the class.
The students quickly called out. I could not determine who was responding, as it all happened so quickly.

“It’s a solid.”

“It’s square.”

“No, it’s a rectangle.”

“It’s made of wood and steel.”

“It’s hard”

Mrs. Brown held up her hands and motioned to slow down the rapid pace of responses.

“Ok, so now we know what matter is and now we know what properties of matter are, right?”

The students’ facial expressions led Mrs. Brown to believe that the children did not understand properties of matter. After several attempts of asking the same question: what are properties? Mrs. Brown attempted to use an example. She asked them to describe the properties of an apple. The students responded with the same rapid fire of answers.

“Red.”

“Round.”

“Has skin and seeds.”

“Shiny.”

“Good to eat.”

“Has a core, stem, and leaves.”

Further discussion involved the apple taking up space, and therefore the apple contained matter. With the example completed, Mrs. Brown asked again: What are some attributes or characteristics of matter? Still the student struggled to get the “right answer”. I could see in Mrs. Brown’s face that the students had not achieved the level of understanding she had hoped. She
looked at me frowned, shrugged her shoulders, and flung her hands up in the air. It was not the body language of disgust or despair. It was the body language of helplessness. She just did not know how to get them to the right answer. I was not sure what to do or say, so I shrugged my shoulders in response.

She moved forward with the lesson, using the discussions about matter to led to the idea of changes in matter. Some of the students’ answers went far away from the initial question of the lesson: How do you know whether various changes in matter are chemical or physical? She used another example: a piece of paper torn, and then burned. With this example, she had hoped they could make the connection of matter and the changes it could go thorough.

Finally, she started the activity associated with the lesson and told the students what they were supposed to do and what they should record on the worksheet (Appendix J). The students read the directions at each station, performed the activity, recorded whether they believed it was a physical or chemical change on their worksheet, and moved on to the next station. The worksheets were collected at the end of the class time. There was no discussion or time for reflection or questions. The terms were never defined by the science lab teacher. The experience with the fourth graders was never processed, reviewed or handed back to the students during the rest of my time in the science lab.

The students lined up at the doorway, and filed out of the science lab led by Mrs. Gonzalez, their classroom teacher. Back in the classroom doorway, Pat continued to discuss with me what she thought had happened with the students’ thinking during the discussion on matter. Meanwhile, the next group of fourth graders arrived and were ready to start their science lesson.

At lunch, we spoke about the teaching and learning surrounding the question: How do you know whether various changes in matter are chemical or physical. Pat was under the
impression that the students knew what matter and properties were. She admitted her frustration at not being able to navigate the students to the answer prior to the hands-on activity from the previous year.

It was her belief that the students knew that matter was made up of particles, which formed solids, liquids, and gases. The forms of matter were described by their properties: color, shape, size, weight, length, etc. The students had given examples and she struggled to make sense of why the students did not see a connection between what they gave as examples of properties and generalized properties of all matter.

This was not the first time Pat taught this lesson about: How do you know whether various changes in matter are chemical or physical? What are some attributes or characteristics of matter? In fact, she taught this lesson to the fourth graders for the fifth time that day, each time, varying the lesson and questions based upon what she had learned from the previous class.

In an interview during the first few weeks of school, Pat stated that the best way to learn science was through hands-on activities, using questions.

“Finding out what they do know before that they actually get into it. Finding out little things that they don't know, like vocabulary words. … I think we take it for granted sometimes and because they really don't know. But I think once they actually see what we are talking about, or they have to explain to them, they kind of know. But until they actually heard about it, I don't think they do get it. … They may have heard it. But I don't think they really understood it.” (Interview: August 29, 2003)

In another impromptu conversation, documented in field notes, Pat acknowledged the students’ need to be actively engaged with hands-on experiences. She remembered how she
wanted to learn how to use the computer. Through practical experience and trial and error, she felt that she was becoming “basically” competent.

Discussion- Navigating the River

Just because there is change does not mean that there is growth or improvement. The changing of classes, students moving from one classroom to another with an individual topic taught in a specific room, has been a standard procedure for middle and high schools. Elementary schools are changing and moving toward a discrete and focused content approach, such as the addition of math and science labs, which require student movement. The transition of instructional strategies from one teacher and classroom to another can be disconcerting to students and their learning style. This new culture of movement from one classroom to another requires a shift in thinking and learning for both elementary students and teachers.

*Science For All Americans* (AAAS, 1990) addressed effective learning and teaching practices. While the document maintained it is not the definitive piece of writing on learning and teaching, it does support the principles as necessary components for effective science learning and teaching. Some of the principles for learning include: teaching for understanding, accessing student’s prior knowledge and developing learning experiences from concrete to abstract. The *National Science Education Standards* (NRC, 1996) has also provided a set of standards for science teaching. These teaching standards support the *SFAA*. These additional standards in *NSES* which support inquiry-based instruction include: planning inquiry-based science lessons, facilitating and assessing student learning.
Instructional Strategies

In the planning and facilitating of science content, teachers look to teacher editions of textbooks, as well as state and district science standards. Those documents were designed to be the starting point for instruction: a resource. How the content is taught, the implementation of instructional strategies, is neither emphasized nor encouraged within those resources.

Pat used the school district designed worksheet as a guide for the lesson, and was further hindered by the structure of the worksheet. Was the lesson about matter? Was the lesson about properties of matter? Was the lesson about the chemical or physical changes of matter? Her thinking was that the students understood the concepts of matter and the properties of matter. So, were the students prepared to shift to the next level of understanding? Even though she planned the lesson based upon previous experiences, she was unaware of the true content knowledge of the students.

The lessons were thought out by Pat, based upon what she thought they knew rather than what the students really knew about matter or properties. It was as if the students needed to have advanced knowledge of the concept of matter prior to the start of the lesson. From the class discussion, the students did not have the concept of matter, let alone the concept of properties. Pat’s desire to have the students provide the right answer seemed to overshadow the notion that the students did not comprehend matter or properties.

The types of questions Pat asked the students were limiting. The questions should have allowed her to probe what the students knew about matter and properties. An examples such as, tell me what you know about matter. This would have allowed her to analyze what the students knew about matter and properties, and then adjust her questioning from that point. Instead, she kept asking the same question hoping that one student would come up with the right answer.
Teacher-centered instruction, large group instruction with specific procedural operations, has remained the norm in classrooms throughout America. If teaching is about telling the right information and learning is about listening and regurgitating the same information back, this would denote the mainstream approach of education. Meier (1995, 2002) stated that teaching should be more listening and learning more telling. “Teachers are still telling and students still assume that remembering what they’ve been told is the road to success” (p. 73). In her experiences at an inner city school in Harlem, Meier’s discussed the major tenets of teaching and learning outcomes. Two of those tenets addressed the issue of cooperative learning and performance assessment. Cooperative learning and performance assessment supports meaningful, rich and real teaching and learning.

When the students in the science lab called out answers or waved their hands wildly until called upon, who is listening to whom? Pat missed where one student referred to property as something you own, like a house or a chair. The missed opportunity could have informed her questioning techniques. She could have amended her question by refocusing the students back to scientific terminology; therefore the students may have had the opportunity to answer the questions posed in the science lab.

Strategies for promoting student discourse should include: providing students with responsibilities, using questioning or prompting techniques, and inviting physical participation. The amount of teacher talk, a situation where the teacher does most of the talking, reduced drastically once the strategies were incorporated into the daily routine. Through the use of reframing responses, inviting others to speak, and listening to student responses, the students were better able to articulate their understanding and take into account the views of others.
Others (Dewey, 1910; Duckworth, 2001; Lemke, 1990; Schwab, 1978) well established in the field of teaching and learning, support the study conducted by Kelly et al. (2000).

Pat’s feeling of dissonance with her teaching practice seemed to cause her a great deal of tension; both on a personal and professional level. She was using her own time to learn and discover more about concepts of science to stay ahead of her students. The frustration on a professional level was her intentions to incorporate inquiry-based instruction. The unintended consequences of inquiry-based instruction did not blend well with her prior skills and method of teaching.

**Questioning**

Asking questions is a suitable method to elicit student understanding, but it can also lead students astray from the original intent or focus of the lesson. Duckworth (1987) discussed posing questions without preconceived ideas about the “right answer”. Offering openness to multiple answers, not just open-endedness, to questions gives the student the chance to think things through and share how they came to know that idea. Too much questioning on the part of the teacher may in fact lead the student astray.

Curiosity drives questioning. With an inquiry-based instructional approach, the teacher may first guide the questions, and then the process of question making should be fleshed out by the students. Once the students are curious about a concept or topic, they create their question pathway to learning. The types of questions in the science lab came from the science lab teacher, not from the students. The focus of all questions stemmed from Pat asking a questions and rephrasing it repeatedly.

In the vignette and subsequent conversations, Pat made an effort to ask questions. She was mindful of obtaining students’ ideas, while checking for student understanding of the
concepts. Repeating the same question several times throughout the lesson did not achieve the intended answers. Pat believed that the right answer for matter was that it took up space and had mass. The right answer for properties of matter were to identify the color, shape, state of matter, temperature, chemical composition, density, volume, mass, length, width, or height of the sample piece of matter. The lack of probing on Pat’s part precluded additional ideas from students. Understanding the definitions of chemical and physical properties were a destination much further down the river.

Questioning techniques are supported, encouraged, and modeled for teachers in curriculum guides and teachers’ editions of textbooks. In Bloom’s (1956) taxonomy there are six levels of cognitive understanding: knowledge, comprehension, application, analysis, synthesis, and evaluation. The first three: knowledge, comprehension, and application are considered lower level understanding, such as recalling general facts, grasping the meaning of a topic, and using the knowledge. The second three: analysis, synthesis, and evaluation are considered higher level understanding, such as analyzing the parts, taking parts and making sense of it as a whole, and forming an opinion or judging your work.

Many of Pat’s questions were in the lower level knowledge area (knowledge and comprehension). What are the properties of matter? What is matter? When the students were unable to provide her with suitable answers, her questions did not remain in the lower level, but went up to the next level of cognitive development (analysis, synthesis, and evaluation): How do you know whether various changes in matter are chemical or physical? The use of open ended questions can lead student down a cascading river. The twists and turns in the questions may lead the students into a whole new situation.
The transition from lower level types of questioning to higher level questions was such a major leap that both she and the students seemed to be lost. So, they repeated the cycle of questioning and answering, hoping that clarity would occur the second time around. Once Pat realized she was not going to get the answers she wanted, she moved forward with the lesson. Her thinking was that at least the students got a chance to experience the activity. While Pat remained on the same line of thinking for her questions, she limited her students’ responses. Her goal of the lesson was to have the students identify the states and properties of matter. If she had opened up the questions more and listened to students’ responses, she may have achieved the goal of her lesson.

The National Science Education Standards (NRC, 1996) state that: “In the science classroom envisioned by the Standards, effective teachers continually create opportunities that challenge students and promote inquiry by asking questions” (p.33). While Pat was asking questions, she was asking them prior to the learning experience. It was as if she wanted them to know the answer to the driving question of the lesson before the students had the opportunity to experience it.

Attaining prior knowledge about a concept and eliciting answers from students guides the learning. Using the insight from the answers provided by the students, the teacher can adjust the line of questions and glean out the intended direction of the lesson and its goals.
Assessment

Assessment is used as a tool to gauge the progress of student learning. The learning may be about scientific processes or content. There are two general forms of assessment: formative and summative. Formative assessment is an ongoing process that can occur at any time during the lesson and is used as feedback. A formative assessment can influence how or what the teacher plans for an upcoming lesson. Summative assessment is used to condense the main points learned in a lesson. A summative assessment is frequently used at the end of a lesson.

Pat assessed students’ ability to understand the concept of, How do you know whether various changes in matter are chemical or physical? The final product, the worksheet, however, was used at the beginning of the lesson to determine if the students already knew the answers. She asked questions to check with students about their prior knowledge of matter and its properties, yet was unsuccessful in attaining an appropriate science oriented answer, the answer which Pat had conceived as being correct. She was working with a specific answer in her mind. The students could not answer her questions about matter and properties, because they had not had the experienced the concepts or the context of the words. Because she had a particular answer in mind, she kept asking the same questions over and over again yet, despite of that repetition, she did not get the desired results.

Checking in on student understanding provides the teacher with feedback in which the teacher can make choices about the next step in the instruction. This feedback is constructive and valuable because it can identify student misconceptions. In Pat’s case, she did not feel competent or confident about her content knowledge to allow the students to move away from the original lesson. A teacher’s comfort level with content can direct the flow of discourse in the classroom.
Pat’s desire to maintain the lesson/worksheet as it was originally was presented limited her to the scope and sequence of that worksheet alone. Because the students did not offer the answers she felt that they should have been able to provide, the lesson was stymied.

The next section provides further insight into Pat’s perspective.

Magnets

Ms. Macintyre, a fifth grade classroom teacher, and Mrs. Brown stood at the doorway and chatted casually. They have known each other for many years, so they leaned into each other’s space covering their mouths with their hand as they quietly discussed something. Both had squinted eyes that form when there is a wide and open smile on your face. Ms. Macintyre made a gesture with papers in her hand that she had to leave and did so quickly.

“Good afternoon class” began Mrs. Brown. “Today, we are going to work with magnets. But first I need to do attendance, while you copy the question off the board into your journals. Remember, we will be checking your journals to see if you are doing your work. You get a grade in science, so remember.” She called the students names, one by one, with her back to the class, and waited for the students to say “here” or “present”. Some students wrote question in their science journals, while others turned around and talked with neighboring students. One student wandered over to the table where I was seated and gave me a big hug.

“You doin’ better?” asked Josey.

“Doing better than what?” I smiled and answer back.

“See, I noticed! Aren’t you proud of me” she laughed back. “Mrs. Brown said you weren’t doing so good and that’s why you ain’t been here.”

“Yeah, I had the flu. I didn’t want to give it to anyone” I replied.
“That was nice of you. I am glad you are back.” Josey went back to her seat.

Mrs. Brown started the lesson. “Today class, we are going to investigate the question: What will magnets attract? What does it mean to attract?”

Josey raised her hand, Mrs. Brown pointed and acknowledged Josey. “Yeah metals, it sticks to the magnets. No, it doesn’t stick, it attracts[sic] to the magnets.”

“How can you predict whether something will attract (enunciating the word clearly) or not?” posed Mrs. Brown.

Students showered responses without raising their hands or waiting for Mrs. Brown to acknowledge them.

“Metal things”

“The refrigerator”

“Nails”

“Iron stuff”

“Ok now class, let’s settle down. Well, what is a magnet?” asks Mrs. Brown with a big smile and her hands on her hips.

Peter raised his hand, shook it wildly and leaned forward. He along with many others in the classroom tried to shout out the answer. Mrs. Brown surveyed the classroom and picked Peter to answer.

“A thing that attracts metal through magnetism,” declared Peter in a firm and confident voice. He looked around at his peers for further validation; he sat forward leaning on the table.

“What is magnetism, Peter?” asked Mrs. Brown.

“Uh, I don’t really know.”

“Well what do you think magnetism is?”
“A magnet that sticks to the refrigerator?”

“What makes it stick?”

“It’s electricity.”

“It’s electric?”

The class protested Peter’s understanding of magnets and any relationship to electricity. His peers said that they learned “all that stuff” last year, and why didn’t he remember. Peter slouched down into his chair, resigned to the fact that he did not want to participate any more.

“What do I mean by magnets” restated Mrs. Brown, “What makes it stick?”

“It sticks to iron or other metally [sic] stuff” said Marquees.

“Iron?” said Mrs. Brown with a slight shake and cock of her head.

“Yeah, iron needs to be magnetized by high voltage,” respond Marquees.

“In other words, magnets can be made by placing it under high voltage? Do you place it under high voltage?” asked Mrs. Brown.

“No”

“Ok class, let’s look at the worksheet and see what you remembered from last year.” Mrs. Brown talked with the students about the worksheet (Appendix J) and following directions. She provided the magnets of varying shapes and sizes, such as a horseshoe, circle, bar, or postage stamp magnet. Each student received a magnet and a tray of items to predict then test for magnetic properties. The students recorded their predictions with an orange colored pencil, tested their predictions, and then recorded what they observed in the lesson. Many students played with the magnets and they “tested” items not in the tray.
Discussion- Navigating the River

The preceding experience, as well as the complete data from which it were drawn, suggests the following shared qualities and beliefs about the culture and realities of teaching science in an inquiry-based classroom starting with where the students are:

“To understand how children themselves reach out for meanings, go beyond conventional limits (once the doors are ajar), seek coherence and explanations is to be better able to provoke and release rather than to impose and control” (Greene, 1995, p.57).

Knowing concepts and discussing them are overly emphasized in the world of education. Duckworth (1987) hesitates to even use the word. “Given my background, if there is anything I’m supposed to know is a concept. But the fact is that I don’t” (p. 50). Her belief is that the learners should work in groups and with items from the students’ world to create their version of their concept. Once the learner develops their own sense of understanding, they may be more disposed to receive a conventional concept. Starting with where the learner dwells or what they know improves the opportunity for meaningful development of a concept.

In conversational interviews (Appendix D, November 14, 2003) with students, they had many questions and ideas about magnets and were confused about how magnets worked even after working with them for three rotations.

Kim/Researcher: Tell me about magnets.

Aiesha/Students: Magnets. Magnets, they attract things. They attract things like um steel, metal, steel wool, paper clips, um . . . (pause) . . . I don't know.

Kim: How do you know something is magnetic?

Aiesha: I can tell something is magnetic, um, like, let me see if I touch it, and it's like metal or steel. Or I can just get a magnet and see if it attracts.
Kim: So you're saying by touching it you can figure out if it's magnetic?

Aiesha: Not exactly.

Kim: OK, because then you said you needed a magnet to figure it out whether it would attract to a magnet.

Aiesha: Um….

Kim: How do you know if something is not magnetic?

Aiesha: Um you can tell if something is not magnetic, um, by, um….. (pause). Some things are not magnetic by . . . by . . . say if you get a magnet and you, um, put it on something like plastic. And it probably won't attract.

Kim: What will attract?

Aiesha: The plastic.

Kim: Oh, it won't attract?

Aiesha: To the magnet.

Kim: What questions do you have about magnets?

Aiesha: Questions I have about magnets is . . . (pause). Like how many things does they attract? Like say if cuz magnets they only, um, attract different things, certain things, so if it's like steel wool and it won't attract. Well it kind of looks like it's going to attract.

Kim: What do you mean it looks like it's going to attract?

Aiesha: Um . . . (pause) . . . Cuz you already know it's gonna attract to metals. And it's like metal. If it's metal and it doesn't attract then why won't it attract?

Kim: So if I hear you correctly, you are asking why don't some of metals attract to magnets?

Aiesha: Yes!!
Kim: How would you investigate that?

Aiesha: Um… (pause) . . . (30 seconds) Ok, you can investigate it like, ummmm, thinking of stuff. First, ummm, you see if it attracts and if it doesn't, you investigate it. Like say if I was a scientist and I, umm, I would investigate it by, umm, doing it, doing it over until I find the answer. Thinking is really hard.

Kim: If you had more time to think . . .

Aiesha: The last question I had it was really hard to think. So I was thinking more about investigating.

Kim: So help me out here, if you had more time to think about it could you figure it out?

Aiesha: Probably. I don't know.

Kim: What would you need to figure it out?

Aiesha: What I need to figure it out? By um . . . by . . . by . . . writing it down you know different things, until I get the right answer. Like how to investigate? Like how I just told you.? Like keep thinking like I can investigate it or not. You know.

Aiesha: Yeah.

Santana, shared:

Kim/Researcher: Tell me about magnets.

Santana/Student: Well, they can attract them things and they can pick up a lot of magnetic things that can, like that has a magnetic too.

Kim: How do you know something is magnetic?

Santana: If you get a magnet and put it in front of it and it sticks to it.

Kim: What do you mean by sticks to it?

Santana: If it goes to it. If it goes up to the magnet.
Kim: Well if I go up to you, does that make me a magnet?

Santana: No!

Kim: So how does it work?

Santana: I don't know that much. I don't know. All I know is that um if you take a magnet and something else that is like magnetic, something like metal and then you put it right near the metal, it will stick to it.

Kim: What about things that aren't magnetic?

Santana: Cuz it does not metal-e, where it doesn't stick to the magnet or nothing. But if you get paper and then you get to magnets, and when you put one magnet on top and the other magnet on the bottom. It doesn't mean that the paper is magnetic. It just means that the magnet can go through to the other magnet.

Kim: What do you mean it goes through?

Santana: What do you mean?

Kim: You just finished telling me that you have a magnet on top of a magnet with one on the bottom one on the top and a piece of paper in between. You said that it's not the paper that is magnetic but that it can go through. What do you think it goes through?

Santana: Um … a magnetic force field or something.

Another student, Samir shared his understanding:

Kim/Researcher: Tell me about magnets.

Samir/Student: Well they stick to metals. Not maybe all metals, but the ones that are kind of old and rusted kind. And they stick to others like sand, and it has black stuff with it. When I put the magnet on it, the black stuff only attracted to the magnet. But the sand
didn't attract to the magnet. And . . . mostly all of them are made out of metal, some are rubber, you know that you put on your refrigerator. And that's all.

Kim: How do you know if something is magnetic?

Samir: You can see if it is old and if it is metal and try it out on another old metal thing. And if it doesn't stick maybe it's a new kind of metal that's not a magnet. Or if it does stick to it, then it's a magnet. I tried that before in my house. We . . . I found this magnet thing and it sticks. I was going by and I dropped it and it . . . I put it on the counter and it attracted to a screwdriver. I said this is a magnet. The screwdriver was kind of old and the magnet was kind of old.

Kim: What I keep hearing you say is that it's old and it’s metal. So is that a characteristic of something magnetic?

Samir: And it's kind of rusty.

Kim: How do you know if something is not magnetic?

Samir: You can tell by its… You could try a magnet on it. And if it doesn't stick, that means it's not a magnet.

Kim: You keep saying the word sticks tell me what that means to you.

Samir: Like if it does attract to.

All three students had general experiences with magnets but now armed with new notions about magnetism; they wanted to investigate their questions. By providing an opportunity to uncover answers, student-centered inquiry would have begun to emerge.
Standards- State and District Guidelines

In the district curriculum, instruction, and assessment alignment guide for the fourth grade it indicates that student should investigate the fundamental concepts of magnetism and relate them to the earth’s magnetic fields. These students were not able to explain, let alone develop, the basic concept of magnetism because of they had not experienced magnets in the context of the state and district guidelines.

Pat assumed that the students would be able to develop their understanding of magnets. It was her belief that the students should have known more than they did about magnets and magnetic forces. The dismay from Pat about students’ lack of fundamental science concepts was brought up in two interviews.

“I found that they have a lack of science. Maybe because their regular classroom teacher doesn't do as much science as they're supposed to, or whether the teacher has that much exposure to science. The classroom teacher is so responsible for the reading and writing and if this subject is slighted it's going to be science or social studies” (Interview, August 29, 2003).

“I'm still not sure where my responsibility is as to how much do I need to cover in the year. Because even though I have a guideline as to where I should be and what I should cover, I mean, I don't feel like I can be expected to do it all. And, since I am kind of grouping things so they get a broader picture, I'm not covering everything. I'm not covering everything and it should be on every grade level. In fact, I'm probably covering some things that a grade level doesn't have to worry about. But I still think they need some of the background because they are not getting enough background to be able to do some of these things” (December 1, 2003).
Had Pat accessed the students’ prior knowledge about magnets, she would have been able to determine what the students should have been exposed to in previous grades and adjusted the lesson accordingly. Her desire to accept responsibility for teaching science concepts following the state and district guidelines caused dissonance for her professionally with her peers. She knew what it was like being a classroom teacher, there were pressures in the classroom that she did not have in the science lab. Pat did not have a clear understanding of the objective as the teacher in the science lab, nor did she seek further clarification.

If clarification was pursued by Pat, she might have had the opportunity to teach with student understanding in mind rather than what she thought she was supposed to teach. By freeing up her stress and fear of not doing the right thing, she might have been able to consider what was appropriate for the students rather than teaching directly from the worksheet.

It was Pat’s belief that science was not being taught in the classroom, and she expressed concern about her responsibility to the district guidelines as well as the state assessment test-FCAT.

“Because I guess I’m worried about, am I going to expose them to enough so that they could do well on the science test. Will they be able to have some knowledge as to what they are talking about on the test?” (November 21, 2003).

She recognized the district guidelines are basic concepts and that the realities of classroom science teaching practices do not come close to matching those district guidelines, and yet questioned her responsibilities to the students she teaches.
In boating, if you don’t know how to use an oar, the journey may not occur as planned. Having the appropriate tools and experiences combined can lead to rich and meaningful learning. That is not to say that learning cannot occur, but just that the struggle may be so overpowering, it may leave the learner disconnected and unengaged.

Magnets may be a familiar object to many people. But is it a tool or a toy? A friend teaches third grade, and he often emptied his pockets at the end of the day with items he had collected during the school day. One time I asked him about his treasures. He told me that during class time the students are supposed to have out only items they need and not toys. When a student was “using” something like a necklace with a crystal ball held by the talons of an eagle, he would pose the question – toy or tool? If the clever child was able to defend the item as a tool, the student got to keep it. If not, my friend put it in his pocket for safe keeping, to be returned at a later date.

Pat and the students felt frustrated while working with the magnets. She did not see this as a toy-time, rather a tool-time. In a conversation at lunch, she was surprised that so many of the students had never experimented with magnets at home. Her children had “played” with magnets at home: surely these children had too. The students were frustrated because they wanted to “experiment” with the magnets.

In the students’ efforts to “play” with the magnets, some students took the magnets out of the hands of other students. Taking the learning out of the hands of others can mean a loss of learning opportunities. Pat admonished students and reminded them regularly throughout the lesson to share the magnets. Student “snuck” opportunities to “play” with the magnets when Pat was not looking.
Pat’s students seemed to see the magnets as toys. Learning through exploring is authentic evidence that babies exhibit from birth. Watch a baby play with a mobile hovering over its crib when the structure moves the child follows it with their eyes. As the baby develops, she/he may touch the structure and cause it to move one way and then another. Has the child developed the concept of balanced and unbalanced forces? Did the child understand the concepts of gravitational forces, mass, and weight? Or was the child enjoying the colors and the movement? Was this item a tool or a toy?

Providing learners with an opportunity, within a given structured period of time, to play and experiment can substantially intensify the learning experiences. If the students were given five or six minutes to purposefully play with the magnets, they might have developed some questions of their own to investigate.

Pat’s perception was that the students had work to do and there was no time for playing. The students needed time to explore what they thought they knew about magnets. Once purposeful play is offered, the learning can transcend to using the magnets as a tool to investigate scientific concepts. Did she know they needed to use magnets as a toy first and then as a tool? I don’t know. That would be another research question to investigate.

The need to access prior knowledge would have informed her of students’ prior experiences. There was a missed opportunity to find out more about Marquees idea of electromagnets. That may have led the students to the new level of thinking about magnets. Other students wanted to know more about magnets. Student work (Appendix L) showed that students still had questions about magnets and wanted further opportunity to explore and explain.
Summary

The instructional strategies used in the science lab were dominated by guided teaching; the teacher modeled the lesson and the students followed the model. The teacher’s perception was that she was utilizing an inquiry-based style of teaching. Pat expressed her frustration at not being able to get the students to answer questions they had no way of knowing, because they were supposed to learn that concept in that lesson. She stated that “things didn’t go like I had planned”. Pat believed, and probably still believes, she was using inquiry to lead her students to learning new scientific concepts. In the NSES definition of inquiry, she was far from exhibiting best practices; however she knew she was not getting the results she desired from the lesson.

Pat knew her students did not attain the concepts of matter or magnets. This was the first time she truly considered whether they learned or not. It was important to her for the first time. She expressed a feeling of helplessness knowing the students were not learning what she intended.

How the learning occurred and how it was assessed revealed a picture of Pat’s form of inquiry-based instruction. Throughout the study, Pat tried asking different questions designed to attain student understanding of matter and magnetism. The questions were still designed to elicit the answers she knew to be right. She seemed to struggle to get the “right answers” from the students. While her questioning techniques changed some, such as using more open ended questions, she still challenged her students to come up with answers that aligned with the answers she knew. Asking questions and knowing that you are not getting the desired product can cause a whirlpool effect. This effect can cause the same questions and answers to continue around and around with no movement away from the center of those questions.
Pat’s perception of the correct answer to her questions prevented her from listening and interpreting the students’ answers or perceptions. In the moment, Pat did not seem to assimilate the students’ point of view or understanding. She was not proficient in content to lead the discussion in the direction of the intended goals, not skillful enough to ask probing or open-ended question. Her struggle to comprehend their answers, combined with maintaining order in the science lab left her frustrated and disappointed with the outcome of the lesson. Pat seemed swept up in the wild fold of questions, comments, and ideas.

The make up of student population in the science lab challenged the planning and performing of the lesson. While she was able to adjust some lessons to meet the learners’ needs, the make up of the student population contributed to the outcome of the lesson. Much like standing in the same river, yet never the same water, Pat’s adjusted lessons were different because the students from class to class were different. Some classes were open to discuss their ideas about the lesson, while others waited to be told what to do in the lesson.

Back In the River

The inquiry-based approach to teaching is not for all subjects or all learners. Keys and Bryan (2001) suggested that inquiry is not a specific enough model or method. Moving from traditional hands-on tasks to student guided experiences and then to student as researcher may be one of many offshoots in navigating a river of inquiry. The perspectives of both the teacher and the student shape the overall perceptions in the microculture of the science lab.

Clarifying what the learner knows, through accessing prior knowledge and replacing it with new knowledge is a difficult transition for students. Accepting that learning is about the journey, and not the destination, is troublesome for them and the teacher. Pat perceptions about
instructional strategies, questioning techniques, and assessment led me to believe she knows that she needs more professional dialogue, in content and pedagogy, in order for her to be comfortable with her teaching practice. The concern for content and process must be linked with asking good questions and looking back at what the learner has gained from previous experiences.

Pearce (1999) reminds teachers that learners are naturally full of questions, but have been stifled in the current educational system. In the past, learners have been conditioned through their schooling years to wait for the teacher to ask questions, which will in turn lead the learner to the “right” answer.

Answers may stop the learning process or be used as a springboard to other ideas and questions can be complicated. Questions require much insight into what might lead the learner to meaning. Pat’s hope for students arriving at the right answer prevented her from opening the lesson up to encompass variations on the right answer. The significance is that if the guided question posed by the teacher is not “framed” in a manner in which the learner can make connections to anything the student will not have enough information/prior knowledge to create a question to direct their learning experience. Student-driven questions have a higher success with inquiry. Open ended, stem probing questions are the best to foster inquiry.

The designing and understanding of this emerging inquiry-based classroom necessitate further investigation into the questions and concerns of this promising practice. Now let us look inside the perceptions of students in the science lab based upon beliefs and behaviors of students, as well as how they made sense of learning.
CHAPTER VI

STUDENT PERSPECTIVES

It is within these buildings that the children struggle to make sense of friendships, power relations, and subject matter, and tried to square their new understanding with what they knew of the outside world. Although the world of school was artificial and the values within it strangely at odds with the children’s family and community life, it still had its regularities and it was, as all institutions are, connected to customs of the outer world. Meier, 1995, 2002, p. 122

In the last chapter vignettes were chosen as represented aspects of lessons, including both teacher and student responses to the lesson in its entirety. This chapter on student perspectives offers insights into student thinking by capturing a mixture of individual student vignettes. These mini-narratives provide insight into the perceptions on behaviors and beliefs as well as how the students make sense of their thinking and learning. After reviewing student interviews, class work, and field notes students were chosen that were representative of the population of the school which was a minority majority.

The following vignettes offer wide-ranging thoughts into the perceptions of the students in the microculture of the science lab classroom. The narratives detailed beliefs and behaviors of students, as well as how they make sense of learning. The account described comes from field notes (Appendix K) and student work (Appendix L). Each description is followed by a discussion, in which relevant research is interwoven.

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6 Minority majority is defined as a majority of students who are part of an ethnic minority.
Matter and Its Properties

The World According to Tory

Tory walked into the classroom with the other students. Without stopping at her assigned seat, she wandered over to the tanks containing the tadpoles. The beads in her hair swayed back and forth as she went from one side of the tank to the other, intently examining the content.

“Get out your science journals and write the questions from the board, while I take attendance,” said Mrs. Brown to the whole class. While most of the students opened their science journals, Tory continued to look at the tanks. Her assigned seat was not close to the tanks, but she stood at the tanks until the class was silent and writing the question of the day off the board. She looked around and saw me watching her. She smiled and waved, swinging her beaded braids back and forth, which made a rhythmic sound. Taking her assigned seat, Tory quickly copied the question off the board and started to talk with the other students at her table and the tables around her.

“OK boys and girls, today we are going to answer the question: How do you know whether various changes in matter are chemical or physical? What are some attributes or characteristics of matter?” continued Mrs. Brown.

Tory slouched down in her seat and twisted her mouth from side to side. Then she opened up her notebook and made it look like she was copying the questions again. After exchanging the pencil in the cup twice and making a couple of erasures in her journal, she attentively listened to the other students’ responses. When Mrs. Brown called on her to answer the question presented to the whole class, Tory shrugged her shoulders and cocked her head to one side.
After the whole group discussion, directions were given and the lesson began. Tory was the first person from her group to run to the assigned station, which happened to be the one which I was monitoring.

“Hi, where is the rest of your group?” I asked.

“They’s comin’. What we doin’ anyways?” Tory asked.

“Well, I think maybe you need to ask your group. What do you think you are supposed to do?” I asked.

“What you tell us to do, right?” Tory said with a big smile and her braided hair swishing back and forth.

“That’s not what I understood from Mrs. Brown” I said.

Tory let out a big sigh, rested her whole upper body on the table and proceeded to wait for her group. During the rest of the rotations, Tory followed the other students in her group and she copied what other students wrote down on their worksheet.

When Ms. Macintyre arrived back at the science lab door, the students were told to pass their papers to the end of the table and then to line up. Tory wandered over to the tanks, tapping on the glass. Other students joined her at the tank. Mrs. Brown called to them to get back in line.

The World According to Leroy

Leroy came into the room hopping and skipping. Even though his seat is in the front of the room, he walked around the perimeter, and stopped to look at items displayed around the room. He touched most of the items and ran his hand over them. For every step he took, he hiked up his pants. Finally, he moved to his assigned seat.
“Get out your science journals and write the questions from the board, while I take attendance,” said Mrs. Brown to the whole class. Leroy took a pencil from the cup, looked over at me and motioned to ask if he could sharpen the pencil. I nodded and as I did, I thought better and motioned him to sit back down. I walked over and exchanged his pencil with a sharpened one from another table.

Getting up in the middle of class to sharpen a pencil was frowned upon. The adage - If you let one student do something then everybody will want to do it. The next thing I knew Leroy was motioning to me to come over to his desk. I put my hands up in the air and cocked my head with the “what do you need” look on my face. He pointed to his pencil the tip which was broken. I made a motion for him to hold on. He kept turning around and looking at me.

“Leroy, what are you doing?” asked Mrs. Brown in a not so friendly voice.

“I need a pencil,” he said “Mine’s broke”.

“I thought Ms Dahl got you a pencil,” said Mrs. Brown.

“Yeah, she did, but it’s broke,” replied Leroy. “Hey what is matter anyway? Are we doing an activity? Can I pass out stuff? I made a mistake on my paper. Can I have a new one? What is matter anyway?”

Mrs. Brown made a face that indicated her annoyance with Leroy’s behavior. They both continued trading comments back and forth with remarks. The rest of the class sat there; some interested in the tête-à-tête skirmish and occasionally they added their thoughts to the pencil-sharpening predicament, while others sat totally disinterested. Finally, Mrs. Brown stated that either this type of conversation could continue or they could do the activity- their choice.

A majority of the class told Leroy to “shut up” because they wanted to do the activity. So Leroy silenced himself, but remained subtly defiant for the rest of the class. He would tap his
pencil on the table, and push other students in his group when he believed they stood too close at
the station. He took materials out of another student’s hand, and ripped his matter worksheet in
half when he tried to erase it. At the end of class, he stood in line pushing others, poking some,
and pulling his pants up with every step he took.

The World According to Kumar

Kumar walked quietly into the classroom, hands in his pocket, looking over the top of his
lop-sided glasses. With his hands still in his pockets, he tried to sit down in his assigned seat, but
another student at his table slid into Kumar’s seat. The other student looked up at Kumar with a
big smile and said, “I am sitting here today. Got a problem?” Kumar shrugged his shoulders and
sat in the only other chair available at the table.

“Get out your science journals and write the questions from the board, while I take
attendance,” said Mrs. Brown to the whole class. Kumar still sat with his hands in his pockets.
As Mrs. Brown called attendance, she noticed that Kumar was not in his assigned seat. She
cautioned him about sitting in the right seat, and he just shrugged his shoulders, and moved to his
assigned seat, hands still in his pockets.

Mrs. Brown discussed the lesson and procedures for the activity on matter. As the groups
moved to the stations, Kumar’s table came over to the station I was monitoring. The students in
the group went through the activity as suggested by Mrs. Brown, and then they went back to
their table to record their answers. Kumar hung back at the station with me.

“How’s it goin’, Kumar?” I asked.

“Well, it’s ok. Nothing great,” he replied.

“Looks like you’re having a hard day,” I posed to him.
“Yeah, well, I’m not Mr. Popular with my group you know. I knew most of the answers, I know about matter. But I guess that’s the way it is,” he said.

“What makes you say that, Kumar?” I asked

Kumar shrugged his shoulders with his matter worksheet in one hand and pencil in another. He continued to move from station to station, passively participating in the activities. When Mrs. Brown visited his table at the end of the period, she reminded him to put his name on his matter worksheet. Willingly, he took a pencil and wrote his name on his paper and passed it in.

_The World According to Jack_

He was the first one to race in sit down, take out a pencil, and start tapping/banging a rhythm on the table. Jack looked over at me and asked what we were going to do today. I pointed to the question on the board, he whipped open his notebook, looked at the question, wrote a word or two, looked back up at the questions, wrote a word or two until he had the whole question written down in his science journal. As Mrs. Brown took attendance, Jack started tapping/banging a rhythm on the table with his pencil.

“Who is doing that?” Mrs. Brown asked.

Jack raised his hand and said he was doing it. Mrs. Brown asked him to stop, which he did for a total of about thirty seconds, and then he started again.

“Who is doing that, again?” Mrs. Brown asked.

Jack raised his hand and said he was doing it. This time he tossed the pencil into the cup and sat with his hands folded, again for about thirty seconds and then he started to tap/bang on the table with his hands.
An introductory example about matter was reviewed, directions were given about the activity, and the students went about following the directions. Jack went from station to station writing down answers on his worksheet. When he completed all the stations, he excitedly brought his paper over to me to show me his results.

“I had fun today. Want to see what I learned about matter? This was really neat. Real science stuff. I think I got some right answers too!” The enthusiasm in his voice and on his face was contagious. Several students quickly gathered around me to share their discoveries about matter and its properties. When everybody had shared theirs with me, Mrs. Brown asked them to be seated. Jack hung back next to me and asked, “Will you use this in your research stuff?” proudly showing me his paper again.

Discussion-Navigating the River

Students come to Specials from their regular classroom, meaning there may be time for the classroom teacher to give the Specials teacher details regarding student behaviors or actions. The students bring diverse experiences to the classroom, many of which are unknown to the science lab teacher. It is not that she does not care about the students; she has a limited amount of time to cover a lesson. Divergence by one or two students is not acceptable, which is made clear from the start of class.

The preceding experiences, as well as the complete body data from which they were drawn, suggests the following shared qualities and beliefs about the perceptions of students in an inquiry-based science lab classroom: environment, responsibility of the learner, and assessment.
Environment

There is a saying that actions speak louder than words. Student behaviors are an under-riding current in the classroom. If a student is having a bad day, those behaviors and actions can set the tone for the class period or even the whole day. The ability to express one’s opinions or ideas is strongly encouraged by the *NSES* (NRC, 1996). The environment in which the teacher and students work help define the overall perceptions.

Communication is a central tenet to inquiry-based instruction. On a basic level, communication requires learners to interact with others to express their ideas and thoughts. A fundamental characteristic of inquiry for students in grades 5-8 is to become experienced in scientific procedures and explanations: “With practice, students should become competent at communicating experimental methods, following directions, describing observations, summarizing the results of other groups, and telling other students about investigations and explanations” (p. 165, NRC, 1996).

What about the student that is not given time to “practice” or even initially, to engage in scientific communication? From the start, students may be in need of further opportunity to employ the skill of communicating. Engaging students in an open dialogue and asking students to share their thoughts on a topic can be a risky endeavor for a teacher. The students may lead both the instruction and learning down a wild path that was nowhere near the original destination the teacher had intended. Teacher talk influences student engagement.

Pat tried to navigate a discussion but expressed later at lunch that she felt rushed and even embarrassed by Leroy’s behavior. She said he did not show respect for her.
Kim/Researcher: You were just talking about respect. Respect for you as a person, the teacher? Or respect for the content, the subject, science? So when you say there is no respect, what do you mean by respect?

Pat/Teacher: Well, knowing that they are the student and I am the teacher. That I am up in the front of the room giving them the information they need to know about that lesson and that they can have a successful day. Respect would be following those rules of being attentive and listening and paying attention to the instructions so that they know what they need to get through the day. Respecting me as the teacher, you know the adult. Like in the sense I respect them and what they need to do. I listen to them and respect their answers.

Kim: One of the things my friend Micky and I have talked about is our similar definition of respect. Do you think your students have a similar understanding or a common understanding of what you mean by respect?

Pat: I am not sure if they do. I don’t know? Because if you ask them do you, for example, say shut up when we are talking? And you ask them would they say that to their mother? Of course they would say no. And then ask them why they wouldn’t; they say that they would get in trouble. They would say they their mother would hit them or swat them or whatever. When I ask them why do they do that to me, they don’t have an answer. I don’t think they see a connection that this is an adult taking charge. I don’t think they see the connect of you are the teacher and I will respect you. I don’t have to respect you I don’t have to listen to you. I would probably say most of the students, yeah most of the students know that you are the teacher. You are in charge here. I don’t know
if they don’t know how to give the respect, maybe. But here again, you look at kindergarten and they know. They do.

Kim: Yes, in their own little special way.

Laughter.

Pat: True, true.

Kim: In the private little universe of kindergarten, I wonder what they know about respect?

Pat: Yes they are learning. But by fifth grade you would think they would know.

(October 14, 2003)

Some teaching talk can inhibit student interaction, while other talk can promote student engagement. Crawford et al. (2000) suggested that a teacher’s sincerity and honesty with exploration of ideas and answers leads to advanced views and thoughts on topic in class. The teachers that opened themselves up as a learner and partner is learning, rather than the use of the authoritarian model, were more likely to have students take on the role of being a responsible learner. If students afforded the opportunity to become engaged in the classroom discussion were more likely to engage in scientific activities, such as inquiry processes and social procedures.

Open minded, inquiry-based instruction can promote better communication. True dialogue is an ongoing practice developed among students. This allows the students to formulate their thoughts with their peers in small groups. By developing communication skills, such as asking questions, the student becomes a person in charge of thinking and clarifying their own thoughts.
By providing a structure for students to express their understanding of a concept, students can self-talk and organized their thoughts. The opportunity to focus conversations around content allows students to think concept through with their peers. It also permits them to discuss what they think they know and what questions they might have about the concept.

Tory found that by “looking busy”, she would not have to communicate. Leroy sensed that if he kept asking questions, and got Mrs. Brown off track, she would not call on him. His peers dismissed Kumar’s knowledge of matter, and his behavior and action indicated a lack of interest and opportunity to share his thoughts, while Jack confidently refocused his behavior and action on sharing his understanding, without regard for what was going on in the classroom. These four vignettes represent the role of communication in an emerging inquiry-based classroom.

If students are provided opportunities to ask questions or offer answers, they may be more involved in their work. The involvement in the assigned task might take on more meaning to the learner, therefore, making the experience rich and real. Involvement would also allow students to submit to others the perspective.

Responsibility of the Learner

Students prefer structured activities because they are accustomed to following step-by-step instructions to obtain specific outcomes. The learning experience becomes focused on the teaching rather than the learning. The students want someone else to take responsibility for the activity. If something goes wrong or the “right answer” is not obtained, the student can blame the teacher, the holder of the “right answer”.

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Two students expressed concern for getting the right answer in their science journals. “Hey Ms Daul [sic]. I like this class. Am I doin' my work right? Write me back!!” wrote Gail. “Did you ask Mrs. Brown about making rockets? Please talk to her. And I don’t think I did what you wanted me to do today. I can do it over and do it right if you want me to,” wrote Jose.

White and Frederiksen (2000) indicated that through understanding, performing science, and social context of performing science, students would acquire self-regulatory skills. These skills allowed the students to justify their own work as well as their peers. This study used small groups as part of the social context.

The concept and shared understanding of a portfolio could be developed with the student before the assessment tool could be implemented. If planning and modeling the complete portfolio process could give the students a reason to be responsible and to communicate and validate their work. The teacher can then focus on the product, remaining non-judgmental about behaviors.

Reinforcing the thought of responsibility through student work, such as portfolios, and an environment for discussion can lead to rich and meaningful learning. The teacher would need to describe and model the process for students. Knowing the expectations and having a model from which students can mirror the original process can authenticate the learning process.

Assessment

Assessment and evaluation are two terms that are often interchanged (Krajcik, Czerniak, & Berger, 2003). Assessment focuses on the learning, while evaluation focuses on the teaching. Assessment is based upon learning for understanding, and evaluation is based upon judging the teaching.
One time, a parent asked me how often I taught for understanding. That question has remained with me for many years. Was work students assessed for understanding or evaluated for teaching? Each time I look at student work that question rings in my head: Is this assessment about the understanding or is this evaluation about the teaching?

Feedback, a form of assessment, on student work can be either positive or negative. It allows the teacher to closely examine the product and provide solid evidence of student understanding (Harlen, 1999). The implementation of an assessment procedure requires thought and planning.

Cody (2003) suggests a preassessment be given before any teaching is started. Preassessment gives the students an opportunity to share what they already know about the topic, and a chance for the teacher to build upon that prior knowledge. Cody states: “I am using assessment not only as a measurement of achievement following instruction, but as a tool of instruction as it unfolds, informing me and the students so that we can work together to learn from each other.”

Pat did start off each lesson by accessing prior knowledge, but then jumped into examples to which the students could not connect. As she walked around in class, she focused more on what the students were doing, rather than what they were learning. During one session where we reviewed science journals together, Pat commented on the student work in the journals:

“She is getting more detailed. I mean, she is actually thinking about what she is doing. Before it was . . . oh, I have to do this, so I'm just going to write it down. I'm not going to really answer it. Of course she was one that was getting in a lot of trouble at her table, you know fooling around, and goofing off. Whether she understood, I'm not sure. But if
she really understood, I'm not sure with her. I think she did, but she didn't produce. Now I can see she’s getting it” (December 1, 2003).

Assessment while not always formal allowed Pat to see what the students understood or had questions about concepts. There were times when she did review students’ journals and saw their questions.

The following data were from students journals. The students wrote about their experiences using round plastic cases containing a mixture of sand and iron fillings. The students used horse shoe, bar, and postage stamp magnets.

“If you put the bar [sic-magnet] on there only a little bit of the black things will stick up. It is not like the wand [sic-magnet]. I wonder why?” (Jose, journal).

“If you put the postage stamp [sic-magnet] on the case with black and brown sand, it will go up. Why?” (Gail, journal).

Their questions could have lead to another level of understanding about magnets. There was an opportunity to assess and evaluate what the students understanding and their need to know more to the next level of knowing more about magnets. Missed opportunities for further investigation left students with burning questions and no place to probe.

An environment that promotes discussion, responsibilities provides ownership, and assessment draws together everything to measure learning.

The following excerpts, derived from the classroom observation and interview, provide additional insight into student perceptions. These experiences demonstrate ways of knowing, telling, and describing, and then ways of connecting and organizing.
Magnets – Part I

“Good morning class. Today we are going to work with magnets. I am going to pass out a worksheet for you to use today.” Mrs. Brown walked down the center aisle passing out enough worksheets for each person at each table.

“Now let’s sit up straight and tall boys and girls. Today we are going to make predictions using magnets. What does it mean to attract?” asked Mrs. Brown.

Several students responded by stating that a magnet sticks or attracts to other metal objects. Mrs. Brown reminded the students not to use magnets around televisions or computers. She said she was not exactly sure why, but told them just don’t do it.

“Ok, boys and girls, take out the orange pencil from the cup to make your predictions about whether you think the objects will attract to a magnet.” The students made their predictions, tested them, and then the class discussed their findings.

In an effort to guide students through a learning experience, Pat found that using a worksheet as a strategy to focus the learning worked well. Having the student defend their thinking was an inquiry-type attempt to communicate their understanding.

Individual students talked about “metal fabric”, “disattracting”, and “properties”. At first Pat looked over to me with a look of panic. The students that provided the answers believed that they supplied an acceptable answer to the questions asked. Pat once again looked over at me. Honestly, I had no idea what the “metal fabric” was, but I did have a guess about the “disattracting” and “properties”.

I raised my hand, Pat acknowledged me, and I asked, “Tell me about the metal fabric”.

Gail turned around and said, “I would love to tell you about the metal fabric. I have never seen stuff like that before. What is it? All those little metal threads all over the place.”
“Gail, I still am not sure what you are talking about.” Then it dawned on me: metal fabric . . . metal threads . . . steel wool. Before I shared my big WOW for the day, I asked her to show me the item. She walked over to the supply table and picked up the steel wool.

“How did you work out that term?” I asked. In my mind I asked myself, how in the heck did she pull that together?

“What do you mean?” Gail responded.

“How did you figure out a name for that stuff?” I asked.

“Well, I knew it was metal and it looked like threads, so I guess that’s how I named it.” Gail had a big smile on her face as she replied.

With that in mind, I asked Drew how he came up with the term “disattracting”. He shared that they had been studying prefixes and suffixes. He knew that the prefix “dis” meant away or remove, so he assumed that when two magnets came together it was “attract” and if two magnets moved away it was “disattracting”.

Magnets –Part II

With the tray of items in front of them, Jose experimented with each item. Even with repeated warnings from Mrs. Brown about leaving the items in the tray until it was time to start the activity, Jose seemed like he could not resist. Mrs. Brown finally finished giving directions and the students started the activity.

Jose and Kristin huddled together over the tray of materials. Their voices were soft and filled with questions associated with items in the tray. The worksheet was pushed off to the side and a pencil rolled off the table. They hardly noticed that I pulled a chair up next to the table.

“Would you mind if I hung out at your table today?” I asked.
Kristin smiled and nodded, while Jose wiggled in his seat.

“What are we supposed to do?” asked Jose as he lined up all the items on the table. Kristin shrugged her shoulders. They both looked up at me. I shrugged my shoulders and told them I was just here to observe what they were doing.

Kristin took the orange pencil and started to mark her predictions on the worksheet. Jose looked at her worksheet and began to mark all of the items.

“No, that’s not what you’re supposed to do. Look here. See, you make a check or X if you think the magnet will work on it. Then we see whether we’re right,” said Kristin.

“Why don’t we just do it, then mark it?” asked Jose.

“I’m not sure, but that’s what Mrs. Brown said to do, ok?” asked Kristin.

They laid the items from the tray out on the table. Jose tried to line them up like the list on the worksheet. The list on the worksheet was vertical; Jose’s line of items was horizontal. He had a hard time lining up the check with the correct column. Kristin made a suggestion that they line the items up vertically, that way they could match it up with the worksheet. Jose pointed to the whiteboard saying that was the way they were supposed to organize the items.

Because Pat taught kindergarten through fifth grade, she had many things written on the whiteboard, some of which did not correspond to Jose and Kristin’s class. In fact, Jose was pointing to something that the kindergartners had done earlier in the day.

Frustrated, Jose shoved the items over in front of Kristin and folded his arms in front of him with a scowl on his face. Kristin once again rearranged items to be tested. Jose collapsed onto the table and frowned at the items. He picked up one item, tested it with a magnet, and then repeated the process with each of the items. Jose never did complete the column of predictions, but he did complete the column of results.
I asked if I could see their worksheets. Kristin had followed the directions Mrs. Brown gave at the beginning of class. She made her predictions in orange, and then used a regular pencil to mark the results of her tests with the magnets. Jose’s worksheet had both checks and Xs in the result column and nothing in the predict column. I asked him to help me understand his work. He explained that the check meant that the item was attracted to the magnet, and the Xs meant that the item did not attract to the magnet. I asked him how Mrs. Brown would know what the symbols meant. Jose said she would know.

As the next class came in, I gathered up the rest of the worksheets from Kristin and Jose’s classmates. As I looked through the work, I noticed some of the students had done the same thing Jose had done; used checks and Xs to mark their tests in the results column. Some students used an orange pencil throughout the whole worksheet. Other students clearly erased their predictions to match the results.

This made me stop and wonder: did the students understand the purpose behind using an orange pencil? Were they aware that predictions are speculations based upon what they think they know at that time? So many questions swirled around in my head. I had to talk with Pat, but knew I had to wait until lunchtime.

At lunch, I launched into a series of questions. Realizing I needed to slow down, I focused on my first one: why did she believe the students erased their predictions?

Kim/Researcher: Like I said, I was just wondering . . . about having the right answers.

Pat/Teacher: Did you notice that in the class on Tuesday?

Kim: It wasn't as apparent. Or maybe I was just not paying attention to it.

Pat: And maybe because they had a substitute there was stress with the prediction. Kim:

But you did it one day before that.
Pat: That was Monday, yeah.

Kim: Maybe the first day I was trying to understand what was going on and the second day I just wanted to be able to support the substitute. The third time. The third time is the charm (laughter). The third time being able to really look at what they were doing, process.

Pat: Well I just know that last year there were a lot of students that predicted. And when they did this test, and they did almost the same that thing with the bags of materials. That they were constantly erasing their answers and putting the right answers. So this year, I decided to try to see if making it in different colors would make a difference. But here again and here we found some to try to erase their orange answers you know the prediction pencils to make their changes it was very obvious.

Kim: The whole idea of being right.

Pat: I know. I think it's stress. And I do know that when I was in fourth grade they had a hard time to make guesses because they didn't want to be wrong. They were afraid to be wrong. They didn't want to take that chance. Seems a little bit better now, but I don't know. (November 1,2003 interview)

Still, I had questions for the students about how they went about making sense of their world.

Discussion-Navigating the River

Learning is a social experience. Giving students the opportunity to show that they know about a concept gives them a chance to develop their critical thinking skills. The realities of student perceptions are they produce work with answers, often with predetermined “right answers”. Students need a vehicle or process to display or articulate their way of making sense.
The process of sense making is crucial to the learning. Without understanding of how the student got his or her “right answer” the process of rich and meaningful learning is lost.

The preceding experiences, as well as the complete data from which they were drawn, suggests the following shared qualities and beliefs about the perspectives of students in an inquiry-based science lab classroom: ways of knowing, telling, and describing and ways of connecting and organizing.

Ways of Knowing, Telling, and Describing

Knowing the right answer and being able to tell it to someone can be like revealing a great and wonderful secret. Comprehending and communicating facts can be seen as a source of power. It is an unwritten social factor in the classroom: smart students have more influence over what the classroom knows or does.

Lemke (1990) discusses learning as a personal progression rather than a group aspect. Students need to work their way through thoughts and answers before they are able to express themselves to others. Teachers can help or hinder that process. Control of the direction or focus of the classroom discussion influences student responses and interaction with the teacher.

Opening up questions with probes and prompts like- “Tell me more about that” or “I’m not sure where this is going”, or “Could someone explain a little more about what we are talking about?” would have a tremendous impact on students’ inquiries. Duckworth (2001) suggested that in addition to using opened ended questions to foster student sharing their understanding, teachers should use the student words. She proposed that teachers use student generated terms to form questions and promote further discussion.
I sat down with Gail and the members of her table. I asked them to explain how they went about organizing their investigation into testing magnets. Flowing directions were important; however, they expressed a need to test things not on the tray. When I asked them why, they replied that some of the items not on the tray were similar to items in the tray. An example was the leg of the desk and metal around the whiteboard. After they made their predictions and tests, they wrote down their results in an extension of the columns on their worksheets.

Students need the opportunity to create their understanding based upon the ideas they develop. When learning is contrived and too structured, the student are more likely to memorize what someone else believed to be important, and “learn” about the topic through someone else’s eyes.

In another lesson, students magnetized a nail. Pat modeled for the students what they needed to do and students replicated the process. Even though the student mimicked the process, but I was unsure if they knew what was really happening to cause the nail to become magnetized. “What I learned today about making a magnet is that if you rub something medal [sic] against a magnet 50 times, it will become a magnets but weak” (Gail, journal).

“You can make a magnet by rubbing a nail with a magnet, if you rub it almost about 50 times in the same (esact [sic]) direction. I learned that if you put the nail on the magnet, and rub it 50 times the magnet give the nail force to attracts [sic] things” (Jack, journal). After reading journals with these comments, I was unsure what they knew about how a magnet was formed. I wondered if they knew about the alignment of changes with the poles. Knowing this could have transitioned into a discussion on changes and poles of magnets.

Without communication skills students are left without a possibility to share what they know about a topic or participate in classroom discussions. Iwasyk (2000) found that by
emphasizing and modeling open-ended questions her students became better listeners and sharers. In an effort to not judge students’ answers as right or wrong, the teacher chose not to answer the questions. Instead, teacher asked the students a question or remained silent to give other students a chance to offer up their thoughts. Her students’ description of the Winter Solstice was a way for her to observe in her students thinking process.

Encouraging student elaboration was also linked to student predictions in another study. Hogan and Corey (2001) found that when students made predictions and designed investigations based on the predictions, it was important for the students to elaborate on their original predictions at the end of their investigation. Some students made pragmatic conclusions on what they saw in the end result of their investigation, rather than revisiting the original prediction. The implication was: How did the teacher balance students’ perspectives on predictions and conclusions with the process of inquiry? How does a teacher deal with the link between a student’s desire for the “right answer” and the development of inquiry-based instruction?

Students’ perceptions of needing to know what is truly expected of them in their environment, is an important step in learning, rather than uncertainty. When a teacher diverges off onto a subtopic and then does not follow through with the original topic, students can become unsure what concepts they will need to know. Students do not know what to do with the information that is provided; they have no way of knowing if it is important or correct.

Not all students sought right answers. Sometimes students did not need to know the right answer; but rather to use their questions as an opportunity to build upon and continue their learning. However, this approach to open-ended learning may not be an appropriate strategy for all fact related concepts.
Ways of Connecting and Organizing

Constructing scientific concepts and floating around in uncertainty can make learning a challenge. Young children use their senses to interact with their environment. Even though they may not verbally express what they know, learning is occurring. Later, as the child develops a repertoire of activities, only then does the child have the ability to hook the experiences together; the wider the experience range, the wider the possibilities to make connections to other experiences.

Learning is not a linear process. Learning takes time. Teachers have students for up to 6 hours of contact time during the day; lunch and specials aside. Connecting concepts does not happen linearly, taking time to develop the student’s ideas can cause teachers to become impatient with students as the students struggle to connect and organize their thoughts. Students need to find their way by thinking concepts through with their own schema. Imposing “the right way” is not always successful. Students should be given the opportunity to worry ideas and thoughts into place. If teachers can make the connection between their understanding and children’s understanding, the insider’s view will help everyone understand.

By asking Jose how he organized his answers on his worksheet, I was better able to understand his thinking and the thinking of similarly minded students, just as when I asked Gail to help me understand how she came to understand the term metal fabric.

I shared those two stories with Pat over lunch. She was amazed that she missed the variations of student-generated terms, specifically metal fabric and disattracting. Pat explained that she was so busy trying to get through the lesson so that the students could get to the activity, she lost sight of listening to the learning. With Jose’s inventive, self-proclaimed answering system, Pat shared that she saw that too, but had not asked what it meant to the student.
Grotzer and Perkins (2000) work examined causality models from simple to complex. If part of the puzzle or an essential step is missed in the learning process, the learner may not be ready to understand the total concept. One aspect of the research dealt with self-organizing systems. Self-organizing systems is a way for the learner to take messy, nonlinear, or chaotic causality models and work them into an understandable pattern without the assistance of outside help or a specific model; this was even true with difficult concepts. Students had the opportunity to discuss and self-organize their thoughts about the causality models fared better than students who were told or shown the answer. The students who were told the answer found it difficult to accept the answer, because the answer did not make sense to them. It was harder for the students that did not use the causality model to express what they learned and to make conceptual connections.

Scaffolding experiences to make connections can be used to investigate the metacognitive views of inquiry process Through the use of a reflective assessment process the students may be able to understand concepts better than students that had not experienced the assessment tool.

Pat realized the need for student reflection:

“I guess I really didn't realize that reflection is really important. And I think I've kind of rushed through that and other classes. I don't think they have enough time to reflect. And I know we have started at the beginning of the year, because I was trying to cut the class five minutes short before they were supposed to leave, so they could have the time. I kind of got away from that. But with this lesson, we did have that time. And I think it was really, really important that they do reflect. I'm not sure, you know I walk around and I see their papers, but I'm not sure it's happening in all the classes. I do notice that they are
writing more than they used to at the beginning of the year. Or just taking the question
and writing “I learn how to make a magnet today”. That's what we were getting at the
beginning of the year” (November 21, 2003).

Students need the opportunity to discuss and organize form themselves what they think about the
lesson or questions they may have developed during the activity. They also need the chance to
share their understanding. This process lets students adjust and modify their thinking based upon
new information from the larger group.

Summary

The teacher helps shape the perspectives of students in the classroom; the knowledge,
beliefs, and values the students had may have been done consciously and/or unconsciously. “It’s
boredom and anxiety that drives concentration away; fidgetiness appears in first grade and grows
worse over time (Meier, p. 47, 1995, 2002).

I have a stone tile that says: “Prepare the child for the path, NOT the path for the child”. Students who “own” their learning process can go out and make sense in the world. I believe that
every parent hopes that they have prepared their children for the path so that the children can
take care of themselves. Students want to be successful: no child plans on failing; they need the
chance to show that they know about the topic at hand. The ability to exhibit sense making for
students provides them with control. This control gives them the power to go out and make sense
of other things.

Students expressed a desire to know more about concepts in class. While Pat did use
some of the questions to start new lessons, an example was a magnet’s ability or inability to
attract through substances; the concepts were not developed for deeper understanding. The
students expressed a desire to experiment and investigate their questions. If students are not provided an opportunity to express their ways of knowing, telling, describing, connecting, and organizing concepts and ideas, students can become frustrated and disengaged in the lesson and overall learning.

Pat’s questions were derived from Pat’s experiences and understanding, not grounded in the students’ experiences or understandings. She was not able to glean student experiences and understandings and make use of that information to expand the class discussion. Listening to student’s answers and ideas is a way to assess their learning and what is the best way for them to build their own thinking.

In summary, the perception of students influences the perception of the teacher in the classroom. Building connections, through shared understanding of both parties can help them to strengthen the teaching and learning. This connection must be made by someone. Someone must take a step forward toward listening and understanding the other.
CHAPTER VII
OPEN WATER AHEAD

Heraclites’ observation about standing in the river, but never the same water was the reoccurring metaphor throughout this study. I was consciously aware I was in the water of the river; yet I was taken back by the course. While in the river, I was often times, swept away by the swell of classroom action, while at other times, I enjoyed the gentle drift of quiet reflection. At all the times, I kept coming back to the questions: What is the microculture of inquiry-based instruction in an urban, low socioeconomics elementary science lab classroom? What are the teacher perceptions? What are the student perceptions?

The goal of this study was to gain insight into inquiry-based instruction in the science lab of an elementary school using an ethnographic approach. To deeply understand my question, I immersed myself in the daily culture of an elementary school and the science lab. Knowing that I did not know about the culture of an elementary school, I started with questions and trepidations. What did I know about the culture of an elementary school? What did I know about the culture of teachers in an elementary school? What did I know about the culture of students in an elementary school? The water was cloudy and I was confused as I navigated, using my understanding of middle school culture to make sense of elementary culture; both were definitely bodies of water, but with very different courses.

An ethnographic approach was used in this study as a vessel to tell the story of inquiry-based instruction in an urban, low socioeconomic elementary school setting. The story recounted what happened over a six month period of time. Some research is evaluative or definitive in
nature, ethnographic studies focuses on telling the facts and allowing the reader to judge for themselves what is valued and meaningful in the study.

What I Learned in School

As I launched into this story about inquiry-based instruction in an urban, low socioeconomics elementary science lab classroom, I did not realize that the role of inquiry would become a minor focus of the study. I thought I knew what was going on in the science lab; that I understood the instructional approach used by Pat. In conversations prior to the study, it was my belief she was moving toward inquiry-based instruction. The daily interaction with Pat and the students in the science lab, along with daily review of data, revealed that the focus of this study would change. I wanted to study about inquiry-based instruction, but that was not going to happen.

I had to rethink my study. Focusing on inquiry-based instruction led me to reflect on what was happening in the classroom. What patterns would be evident or would I see each day in the science lab? It was not until I had been in the science lab for several weeks before I realized I was not going to be examining inquiry-based instruction, but the microculture of science education in an urban, low socioeconomic elementary school.

Several days of examining the structure of the classroom interactions between the science lab teacher and the students led to a revelation and realization of two separate perspectives in one room: a teacher and a student perception. The teacher perception made me think about how Pat and the students interacted with each other in the teaching experiences. The student perception made me think about how the students interact with each other, the content, as well as Pat.
Wolcott (1999) says that ethnographic research “generates fascinating philosophical, ethical, and methodological dilemmas” (p. 14). I was well on my way down a river filled with swells of dilemmas. I needed to remind myself this research was more about being in the river and what I saw from the shore, than about getting down the river.

The right thing was to move confidently in a new direction with a new spin on the original question. What was the microculture in an emerging inquiry-based instruction? What does it look and sound like for Pat and the students? Creswell (1994) suggested simultaneously collecting and interpreting data. By reading, writing, and examining the data, I was able to think about the study in a new way. Glesne (1999) suggested developing a storyline. My storyline of the day in the life of a teacher and the day in the life of a student revealed aspects in the two distinct perspectives. The major aspects in the teacher’s perceptions were instructional strategies, standards based instructional guidelines, and the realities of teaching in an urban low socioeconomic setting. The major aspects in the students’ perceptions were insight into their environment and sense making of elementary school students.

The following sections will revisit the main results; provide implications, and possible suggestions for further research.

Implications

Exploring the microculture of a science lab classroom provides valuable information for schools. The classroom teacher and students are significant partners in education and in this study, specifically science education. As teachers experience students with diverse backgrounds and the influence of standardized testing, teachers find themselves balancing many issues. How can teachers, specifically science lab teachers, learn to listen to their learners? How do teachers
change their thinking about student thinking? How do students share what they know and express their sense making? How do teachers and students communicate their understanding of learning to each other?


Teacher Perspectives

Pat and I stood by the doorway waiting for the fifth graders to arrive. We started talking about what she wanted to teach during the next rotation. Her experiences in a workshop series where we initially met triggered an idea. She thought that determining speed would be a good next activity in the force and motion unit. Speed, like other concepts in science, seemed like a simple concept, until I started to ask Pat some questions.

“What do students need to know before they measure speed?” I asked.

“Well, they need to measure distance with a meter stick and use a stopwatch,” was her reply.

“Do the students know how to use a meter stick?” I continued.

“I think they do, but we might have to remind them about adding the numbers of the meter stick together. I’m not sure.”

“What about the stopwatch?” I asked.

This set off a series of questions and considerations about what the students needed to know before they could determine the speed of an object. Pat had not considered the use of a stopwatch as a prior learning experience that the students needed to have had before using it as a tool to gather data. After we discussed it further, she formulated a plan to incorporate mini-lessons about using tools and skills related to measurement.
How do teachers plan for a lesson without inquiring into the prior knowledge of their students? What experiences do students need to have prior to the next building experience? How do they develop a reflective practice that would help them about what their students need to know and what the students should be able to do once a lesson has been completed?

Beliefs and Attitudes of Inquiry

Promising inquiry-based practices require the development of abilities and understanding of concepts. While the discussion continued, Pat said she was unsure about how to use the stopwatch during her workshop experience. The realization that she had not acknowledged her lack of interaction with items from the workshop, such as a stopwatch until now caused her to reflect on what other experiences her students had not practiced or engaged in. She did not want the students to experience the force and motion activity exactly the same way she had experienced it. She knew she wanted the students to develop their own experiences and ideas.

“Yes, I want them to not have to do it exactly like I tell them. But they can do the experiment and then from there they can hopefully do more. Like changing the variables. Try to find out answers. Last year I don't think I gave them that opportunity. I was still trying to learn the material, figure out the time, and figure out what they could do in that time frame. But this year I'm hoping that I will be allowing them the time to figure it out on their own” (interview September 4, 2003).

Allowing teachers to construct their understanding of concepts and that the interaction between peers gives them an opportunity to expand and explore ideas. Pat understood the need for students to construct their own understanding of the activity, but had not thought through the students’ learning needs. She only had her own experiences to fall back on.
Instructional scaffolding uses experiences that are built upon until the learner can put together a series of ideas in a way that they can construct their own findings. Scaffolding takes into consideration the need to build upon ideas, events, and facts before the learner was ready to receive new concepts. Negotiating the steps toward understanding constructs a new level of learning. Exciting and engaging science experiences should be viewed as small amazing events. Each small event plays a part in the next event forming a work in progress. This provides continuity of thinking and learning rather than discrete learning events, in a student’s life.

In addition to considering student experiences and tapping into their prior knowledge about concepts, Pat reflected upon her questioning techniques. Pat placed her foot in the river of inquiry when she experienced inquiry-based instruction during summer workshops. With a variety of learning experiences and a fundamental understanding of inquiry, Pat waded in to teaching science. While she struggled to get students to a higher level of thinking, she worked hard to figure out how she could make that happen. Pat spoke of inquiry-based instruction in her initial interview.

“Using the inquiry type method, using questioning answering and having them figure it out. Not the teacher standing up there and saying this is the answer. Letting them find out, having them come up with the answer. I think that's the best way that they can learn science” (August 29, 2003).

Yet, five months later, she still struggled with whole group discussions. Her questions were “tight”. The answers that the students gave were classified as low order thinking questions, providing mostly “yes” and “no” answers to questions. If the student did not give the preconceived right answer, Pat did not ask for further embellishment from that student.
Modeling and mentoring are excellent ways to improve teaching practices. Teachers need to see what instructional strategies work and what ones are appropriate for their learners. Again, this takes time and practice to accrue the skills of effective questioning techniques.

A teacher’s ability to be candid with students and allow the discussion to be student-oriented permits students to explore their own ideas. Opening up the discussion and asking the students to draw upon their prior knowledge about topics can lead to a teacher’s deeper understanding about what counts as learning.

In a study by Polman and Pea (2001) found that a series of stages in creating a discussion was useful, yet not always successful. This study indicates that the steps require certain teacher abilities. These skills include being comfortable with students selecting alternate paths of understanding and a teacher’s solid content knowledge. Breakdowns in the discussion stages prevent the teachers and students from moving forward toward new paths of understanding.

Teacher preparation in content and pedagogy and teacher assignment are a systematic issue in public education. If teachers have not been provided with relevant experiences and materials to support the education program in the school, the learning will not be as powerful or productive. The best teachers may not be assigned to the least prepared students. Teachers are assigned to grade levels and subject areas based on necessity to fill a teaching position or desire by a teacher to teach a specific grade level or subject area. While these may be good intentions, it may not serve the best learning interest of the student.

Pat’s perceptions about inquiry-based instruction challenged the definition of inquiry as stated by the *National Science Education Standards*. Preparing and practicing with questions techniques, accessing and incorporating students’ prior knowledge, and developing and connecting together experiences all lead to a rich and meaning lesson. Inquiry-based instruction
requires time to explore content and pedagogy which is appropriate for the learner. Without the essential underpinning of inquiry-based instruction, teacher will look to textbooks and how-to-books solely for a disconnected series of activities.

*Reflection as a Tool for Understanding*

The reflective practice is a process that permits teachers to look back on the teaching and learning by revisiting ideas, events, and experiences. Retelling the stories about teaching and learning can be a way to process the difference between what happened and what was learned about the experience. Reflection-in-action may expand or enhance a teacher’s practice and be later drawn upon to resolve the next challenging situation (Schön, 1983).

Pat realized the need for reflection for her students.

With Pat’s awareness that reflection was important to her students, she later acknowledged she had never really thought about why she did what she did in the classroom. Pat recognized that our conversations made her stop and think about what she was teaching and whether the students were learning.

Teachers want and need time to think about their teaching. Asking themselves the hard questions and looking deeply into the process of learning can be taken for granted. Systematically reviewing data and using that data to inform a teacher about their own practices can add a new aspect to personal professional growth. Voicing questions and processing them provides the teacher with an opportunity to figure out how they came to know and truly understand concepts or ideas. This self-realization and sometimes philosophical process can cause dissonance.
Teacher perception influences student perceptions, while the student perception influences the teacher perceptions. The next section examines the implications in student perceptions.

*Student Perspectives*

Armando walked into the room and sat with Juan. With his back to me, Armando slouched down at the table, trying to hide behind Juan, even though they sat up front. Armando had a jacket about four sizes too big for him with pants that matched in size. He looked like a little boy, maybe a third grader. After chatting with Juan, he wandered over to me and sat down.

“I see you are making the rounds today,” I said.

“Yup” was his only response.

“Would you mind if I sat with your group today?” I asked.

“Sure. You gonna write about me?” he asked with a big smile and a sparkle in his eyes. This was a question he asked most days when I saw him, regardless of where I saw him on campus.

“Alright class, let’s get started with today’s lesson,” said Mrs. Brown. Armando knew this was the signal for him to move to his assigned seat. Slowly, with emphasis on pulling up his pants, he walked over to his seat on the other side of the room.

The lesson was focused on circle magnets. As usual, the students were supposed to write down the question from the whiteboard. And, as usual, Armando did not do it. He looked around and then started to “play” with the magnets in the tray.
Once the lesson was in progress, I went over to Armando’s table. The girls at his table went right to work following the directions on the worksheet Mrs. Brown had provided. Armando continued to play with the magnets.

“Come on Armando. We have stuff we need to do, please,” pleaded one girl.

With a wily look on his face, he turned to me and asked what the directions were for the lesson. I suggested he work with the girls at his table, because this was supposed to be a group activity. All three rolled their eyes and threw their heads back. I was not about to let them off the hook just because I was sitting at their table.

“What do you think you are supposed to do?” I asked.

“Just play with the stuff,” responded one girl.

“No, we are supposed to follow the directions, but I don’t remember what they were. Do you?” asked one girl to the other.

“Look, we got this stuff and a magnet, let’s see if it works,” proposed Armando.

They spent the next five minutes “testing” the magnet on all the items in the tray and some items not in the tray. The girls started to write down answers on their worksheet. Armando continued to test the magnet, and then he put two magnets together. The magnets did not stick together, but they jumped. Armando recoiled back and looked at me.

“What’s that about?” he questioned.

Yes, I saw what happened but I was wondering if he could recreate it and examine what happened. Quickly, before I had time to ask him to do it again, he repeated the “trick”, as he was now calling it, for the girls. The girls, now fascinated by the “trick” wanted to know how Armando knew how to do it. With eyes pleading and hands holding stretched out toward me, he said “I want to know what made it do that?”
“What do you know about magnets?” I asked the three students.

The girls told me about the magnets ability to attract and repel. I asked them to explain that to me like I was in kindergarten. They took turns explaining their understanding of those terms. Attract meant that the magnets “came together” and repelled meant the magnets “pushed away” from each other. In the meantime, Armando kept repeating the process again and again, as if by magic he would reveal the secret to the jumping magnets. I asked him to put the magnets down for a minute and listen to what the girls had to say. He physically turned his chair around and faced them while the girls spoke. The girls repeated their explanations along with using the circle magnets for visual enhancement. After they explained the concepts of attracting and repelling, I asked another question. I was not sure what they would do with it.

“Now that you have heard about attracting and repelling, what do you thinking is happening?” I asked.

“Well, they are repelling,” said one girl.

I knew asking the same question again would only cause frustration. So I kept quiet and they kept on manipulating the circle magnets.

Armando had the two magnets back in his hand; he placed a pencil through the hole in the middle of the magnet. The magnets “stuck” together. Armando frowned. One girl asked if she could try something. Armando was less than enthusiastic about sharing.

“Come on Armando. We are supposed to work together,” she pleaded.

Finally he gave her the magnets, putting his head down on the table. He snuck a look and noticed she had the magnets “floating”.

“Why do you think the magnets are doing that?” I asked.

“Because they are repelling now, not attracting” said Armando.
“How can they attract sometimes and repel other times,” wondered the girl aloud.

“Cuz they got different sides. Right?” stated Armando.

“Well, what else do you know about magnets?” I asked again.

All three proceeded to share what they knew. They agreed that magnets had different sides, but were unsure how to determine which side was “different” based upon looking at the magnets. They agreed that “testing” was required to determine the magnets’ ability to repel or attract.

Armando ran up to Mrs. Brown and shared his discovery. But time ran out for Armando and his table to share their findings and all the students had to move on to the next specials class.

What factors influence a student’s behavior in the classroom? The two girls influenced Armando to become involved to “following the directions” and Armando influenced the girls by not following the directions and experimenting outside the given guidelines for the lesson.

How do students know that they belong in a classroom and that their voices will be heard? The group of three students listened to each other and developed their own group dynamics. By listening to each other they started to develop an understanding of magnets, attraction, and repulsion.

Environment

Perception is a powerful idea. How we perceive others and how they perceive us can be a driving force behind certain actions and behaviors in our environment. Through community building, responsibility and reflection of learning can happen in a rich and meaningful way.

Community building, a way of being together, is a powerful and resourceful process. Juanita Brown calls community “a change or exchange, shared by all” (Senge, Kleiner, Roberts,
Ross, & Smith, 1994, p. 509). The process of building a community of learners is essential to the thinking, processing, and understanding development of learning. Learning is more likely to occur if you know something about the other person. The brain wants to make connections and is more likely to do so if connections to the other person can be made.

Cooperative learning teaches students to work together in a responsible, constructive, and mutually supporting way. Roles may be assigned to assure responsibility of each learner in the group. Various instructional strategies, such as jigsaws, are used in cooperative group settings to provide a structure of accountability. These instructional strategy known as jigsaw was developed by Elliot Aronson (Gibbs, 2001). The main topic, such as properties of matter, could be broken down into mini-topics, such as properties of solids, properties of liquids, and properties of gases. Students number off within their table group and join their mini-topic group. The mini-topic group learns about the properties of matter for their assignment and become “experts” on that topic. Later, the mini-topic groups return to their assigned table group and teach their peers about the content.

Student who know what the expectations are develop a sense of purpose. Directness of instruction should not be confused with direct instruction. Being intentionally explicit about expected behaviors is a cultural issue (Delpit, 1988). Specific expectations couched in learning goals allow the student to know up front what they are responsible for learning and how to behave in the classroom.

While the students are grouped together, they are not always working cooperatively. Does this mean the instructional strategies cannot be incorporated into this classroom practice? I don’t know. I do know it would take time to build community within the classroom.
Reflection is not just a process for teachers, but should be a process modeled by the teacher for student utilization. Providing time and resources to think through a concept honors both content as well as the students learning the concept. Earlier Pat said she wanted to take time, but has yet to figure out a way to build it into her allotment of time.

*Sense making*

In order for students to share their understanding of a concept, they first must have a vehicle to express their understanding. Once the student has developed a way to articulate their grasp of new knowledge, they need the opportunity to communicate this newfound knowledge.

Inquiry-based instruction can be a bewildering process. On the one hand the teacher asks the students to think like a scientist or share what the student knows about a topic. Yet if students have not had interaction with the tools of science or ideas associated with scientific concepts, they have little relevant information to share. Students need a process to share what they know or what they think they know in small groups. These small groups provide a chance for students to express their way of thinking.

Communication skills can be developed through many small and larger group experiences. Driver, Squires, Rushworth, and Wood-Robinson (1994) indicated that the process of sharing individual ideas has an effect on other conversations in the classroom. By bringing together implicit thoughts, larger group conversation can distill ideas into explicit thoughts. Armando and the girls shared their thoughts and experimented with the magnets, given time they may have developed a better sense of the concept of what “sides of a magnet” meant.

Whole group discussion can be a good way to reveal misconceptions and access prior knowledge. It can be used as a probative tool. However, large group discussions can also lead to
frustration on the part of the student and teacher, particularly if the teacher has a specific answer in mind.

When Pat had the student discuss their ideas about magnets, the conversation revealed past experiences and vocabulary development. On the other hand, Pat tried to use the same large forum to get the students to come up with the definition of matter and its properties prior to the students’ experience of the concept.

Using the appropriate instructional approach for the subject matter needs to be thought through and planned. A triadic approach (Lemke, 1990) uses a series of planned questions to guide the students from point A to point B. This process uses a systematic array of thematically linked questions around a specific topic.

Once the concept has been developed or a formative assessment is desired, students need to have a means of expression. Communicating student understanding may come in many forms, such as group presentations, individual reflections or summary statements. Students need to engage in a variety of activities that allow them to construct and demonstrate how they develop ideas and the new possibilities for expanded learning.

If the student perceives there is a right way to complete the assigned task, the student may complete the task the way he or she thinks the teacher wants it done. This notion leads to a contradiction for the students. The concept of the right way to do an investigation goes against the essence of inquiry-based instruction. Student-centered investigations model the nature of science. The nature of science addresses the belief that learners design, investigate, communicate, and debate scientific ideas. If students are chastised or directed to an answer because they investigate outside the perimeters of the teacher-directed lesson, students become disengaged from the learning process.
Iwasyk (2000) expanded her understanding about class dynamics when the students were the developers of questions during classroom discussions. The students not only benefited from listening to each other, but were able to develop expanded and thoughtful questions to ask their peers, making the conversation rich and relevant to the students.

Recommendations for Further Research

Inquiry-based instruction has become a focus in science instructional strategies. Two important considerations for future research are taking into account the teacher’s instructional strategies of inquiry-based science education with diverse populations, and overall teacher preparation of inquiry-based instruction.

For teachers to develop a meaningful sense of learning through inquiry-based instruction, teachers need to investigate their beliefs about teaching science. Not just teaching to the general population, but to all children, bearing in mind their culture, language, or socioeconomic status, is critical to how children can optimize their learning. Teachers should identify, accommodate, and acknowledge differences in culture. By identifying cultural differences, teachers can influence their teaching practices, and avoid the negative consequences associated with widely diverse populations. In addition to identifying their cultural needs, teachers need to know what inquiry-based instructional strategy and content are appropriate for their grade level based upon the state science guidelines.

Teacher preparation in institutions of higher education by way of elementary and secondary science methods course, and professional development by way of continuing education for classroom teachers, should include analysis and adaptability of inquiry-based instruction. By providing undergraduates and classroom teachers, or the teacher-learners, with
practical experiences in inquiry-based instruction, the teacher-learners would benefit from exemplar teaching practices.

Into Uncharted Waters

Being of Norwegian descent I have always had an affinity for water. Many years ago, I received an ocean-themed desk calendar from my sister. One month had a quote from Mark Twain, a noted humorist of the 19th century. He wrote:

“Twenty years from now you will be more disappointed by things you didn’t do than by the ones you did do. So throw off the bowline. Sail away from the safe harbor. Catch the trade winds in your sails. Explore. Dream. Discover.”

I know I would have been disappointed had I not explored elementary school and discovered what science education looked and sounded like from that vantage point.

There are a few items I believe to be true after completing this study:

All students can learn; they need opportunities and resources. Most teachers are doing the best they can; they need support from their peers, administrators and district leaders. Teachers and students need to take time to listen to each other and patiently wait for their turn to tell.

My journey in science education is just starting. The more I learn about the culture of elementary schools, the more questions I have about the connection to my middle school teaching experiences. The more I learn about inquiry-based instruction, the more questions I have about the realities of public education and the high-stakes testing demands. The more I learn about myself, the more I question whether my actions match my words.
APPENDIX A

IRB Approval Forms
August 20, 2003

Kimberly Dahl
222 Delespine Dr.
DeBary, FL  32713

Dear Ms. Dahl:

With reference to your protocol entitled, “A Narrative Ethnographic Study of Inquiry-Based Science Instruction in an Elementary Science Lab/Classroom School Setting,” I am enclosing for your records the approved, executed document of the UCFIRB Form you had submitted to our office.

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur. Further, should there be a need to extend this protocol, a renewal form must be submitted for approval at least one month prior to the anniversary date of the most recent approval and is the responsibility of the investigator (UCF).

Please accept our best wishes for the success of your endeavors.

Cordially,

Chris Grayson
Institutional Review Board (IRB)

Copies: Dr. Larry Holt
IRB File
IRB COMMITTEE APPROVAL FORM
FOR UCF/OOR/IRB USE ONLY

Pl(s) Name: Kimberly Dahl
Title: A Narrative Ethnographic Study of Inquiry-based Science Instruction in an Elementary Science Lab/Classroom School Setting.

Check as applicable (optional):

[ ] Yes  [ ] No Have sufficient assurances been given to the committee to establish that the potential value of this research exceeds the risks involved?

[ ] Yes  [ ] No Written and oral presentations must be given to participating subjects (parents or guardians, if minors) informing them of the protocol, possible risks involved, the value of the research, and the right to withdraw at any time.

[ ] Yes  [ ] No A signed written consent must be obtained for each human subject participant.

[ ] Yes  [ ] No Are cooperating institutions involved? If yes, was there a sheet attached providing the name of the institutions, the number and status of participants, name of the involved official of the institution, telephone, and other pertinent information?

Committee Members:

Dr. Theodore Angelopoulos: ____________________________
Ms. Sandra Browdy: ____________________________
Dr. Jacqui Byers: ____________________________
Dr. Ratna Chakrabarti: ____________________________
Dr. Karen Dennis: ____________________________
Dr. Barbara Fritzsch: ____________________________
Dr. Robert Kennedy: ____________________________
Dr. Gene Lee: ____________________________
Ms. Gail McKinney: ____________________________
Dr. Debra Reinhart: ____________________________
Dr. Valerie Sims: ____________________________
Dr. Bob Spina: ____________________________

[ ] Contingent Approval
Dated: ______________

[ ] Final Approval
Dated: ______________

[ ] Expedited
Dated: August 13, 2003

[ ] Exempt
Dated: ______________

Addendum to OSR-21/IRB
Revised 12/01

Signed: ____________________________
Chair, IRB
Dr. Sophia Dziegielewski
C. **UCFIRB Form**

The complete IRB packet must be submitted by the 1st business day of the month for consideration at that monthly IRB meeting. Please see page 6 of this manual for detailed instructions on completing this form.

1. **Title of Project:** A narrative ethnographic study of inquiry-based science instruction in an elementary science lab/classroom school setting

2. **Principal Investigator(s):**

   **Signature:**
   **Name:** Kimberly Dahl
   **Mr./Ms./Mrs./Dr. (circle one):** Mr.
   **Degree:** Master of Education in Science
   **Title:** Doctoral Candidate
   **Department:** Educational Studies
   **College:** Education
   **E-Mail:** kdahlnor@aol.com
   **Telephone:** 386-668-5129
   **Facsimile:**
   **Home Telephone:** 386-668-5129

3. **Supervisor:**

   **Signature:**
   **Name:** Larry Holt
   **Mr./Ms./Mrs./Dr. (circle one):** Dr.
   **Degree:** Ed. D.
   **Title:** Assoc. Prof. of Curriculum Studies
   **Telephone:** 407-823-2015
   **Facsimile:** 407-823-5144
   **E-Mail:** holt@mail.ucf.edu

4. **Dates of Proposed Project (cannot be retroactive):** From: September 1, 2003 To: May 1, 2004

5. **Source of Funding for the Project: (project title, agency, and account number)** None

6. **Scientific Purpose of the Investigation:**

   The purpose of this research study is to examine inquiry-based science teaching and learning in an elementary school setting. Inquiry-based science is an instructional method, which provides students with diverse ways of making sense of and understanding science in the natural world. Central to inquiry-based science teaching and learning is the variety of experiences all learners bring to the classroom. Central to this research study is to identify those factors that affect the teacher and researcher in planning and implementing inquiry-based instruction, while examining teacher and student interactions in the classroom.
7. Describe the Research Methodology in Non-Technical Language: (the UCFIRB needs to know what will be done with or to the research participants)

This study will employ a narrative ethnographic methodology. A narrative ethnographic study connects ethnography which is a way of seeing or understanding from a personal point of view, with narrative inquiry which is more story-like. The narrative ethnographic approach to qualitative research focuses on the entire picture rather than an individual aspect of a phenomenon. The holistic approach allows the reader to develop an “insiders view” of the detailed and involvement in the research in its entirety(Ary, Jacobs & Razavieh, 2001; Creswell, 1998; Wolcott, 1998). The research in this study will be designed to investigate the naturally occurring events and behaviors of all participants in a science lab classroom. The study will attempt to identify and analyze the aspects of inquiry learning and teaching in the science classroom. This type of research is a natural way to authentically describe what goes on in the teaching and learning of science in the classroom. The events will be described as they naturally occurred within the classroom.

The classroom teacher and her fourth and fifth grade students will be asked to participate in the study. There will be several forms of data collected in the study, they include: audio taped interviews, reflections/expanded notes on the interviews, student work, teacher lesson plans, and field notes. All participants will be asked to complete and sign a consent form prior to the start of the study.

The process of collecting data from the students and classroom teacher will involve the completion of individual audio taped interview. The interviews will be recorded, transcribed and analyzed for emergent themes and patterns.

There will be student interviews at the start of the study, one interview during the middle and one at the end of the study. These students’ interviews are prepared to be conversational, yet guided (Rubin & Rubin, 1995). These questions will focus on their experiences in the science classroom (see attached interview questions). Participants do not have to answer any questions they do not wish to answer and can withdraw from participation in the study at anytime. Participants’ confidentiality will be protected throughout the research process. Their identities will be coded when the tapes are transcribed, to protect their privacy and maintain confidentiality. Only I will transcribe the tapes word for word from the participants.

The classroom teacher will be interviewed to gain initial understanding of the planned learning experiences from last year (2002-2003). This interview will occur only once at the beginning of the study. The interview will be conversational, yet guided. These questions will focus on practices in the science classroom (see attached interview questions). The participant does not have to answer any questions she does not wish to answer and can withdraw from participation in the study at anytime. The participant’s confidentiality will be protected throughout the research process. Her identity will be coded when the tapes are transcribed, to protect her privacy and maintain confidentiality. Only I will transcribe the tape word for word from the participant.

The raw data from all of the interviews will be audio-recorded and transcribed verbatim for each participant. The audio recordings will be personally transcribed by the researcher and any identifiers will be removed during the transcription. The data from the interviews will be analyzed continuously throughout the study. The context of the
interviews will be used to reveal thinking and learning in relation to science lessons at the beginning, middle, and end of the study.

The researcher will create expanded notes and reflections on the audio taped interviews. The data will be reflected upon and analyzed for better understanding of the interrelationship between planning and implementation of inquiry-based science teaching concepts while examining the learning environment.

Sample of students’ work will be collected as part of the study. The student work will be used as evidence of student understanding of science concepts and inquiry-based instruction. Students do not have to provide work if they do not wish to and can withdraw from participation in the study at anytime. Student confidentiality will be protected throughout the research process.

Lesson plans created by the classroom teacher and researcher will be collected as part of the study. The documents will be used to analyze the planning and implementation of science concepts, while examining the learning environment. The teacher does not have to provide lesson plans if she does not wish to and can withdraw from participation in the study at anytime. The teacher’s confidentiality will be protected throughout the research process.

I will add my personal reflections on the lesson plans and teaching practices documented in the study. My reflections will indicate my activities participation in the study.

The data collection will start after the students are given consent letter forms (see attached consent letters) and the letters are signed by the child and the parent/guardian. The teacher will have a similar form to sign. The families and teacher will keep a copy of the letter, and I will keep one copy for my records.

The information gathered during the daily routine of the classroom will be documented with field notes. Field notes, a primary recording tool used by qualitative researchers, will be a daily method of collecting data. This daily log of information will explain and describe classroom routine, activities, and conversations. These notes will also be used to document emerging ideas or themes (Glesne, 1999). This data will be used to support interviews, reflections/expanded notes on the interviews, student work, and teacher lesson plans.

A member check will be made with the participating teacher. A member check is a collaborative process in which the researcher and participant examine data to test out and verify experiences and understandings (Ary, Jacobs & Razavieh, 2002). There will be a review of the audio tapes, expanded notes/reflections of interviews, lesson plans, and student works gathered during the study to explore different perspectives, meanings and verification.

The data will be analyzed through triangulation, a process using multiple sources of data to confirm emerging factors (Yin, 2003). The Long-Table approach will be used to analyze the data (Krueger & Casey, 2000). This approach uses printed transcription of data, spread out on a long surface, allowing themes to be coded. The transcribed interviews will have a number on each line and each page will have a heading denoting the interviewees’ code name. Lesson plans, expanded notes/reflections, and student work will also be printed with a number on each line and each page will have a heading denoting the source and coded source. A color coding system will be used to identify reoccurring themes for frequency and specificity.
8. Potential Benefits and Anticipated Risks. (Risks include physical, psychological, or economic harm. Describe the steps taken to protect participant.

There are no expected physical, psychological, or economic risks for the student or teacher participants. The confidentiality of the student and teacher participants will be protected. Only the researcher will have knowledge of which students actually participate in the study. Student names and the name of the teacher will not be linked with their responses in any publicly shared document. The students and teacher will be in charge of the information they wish to share because they can decide on which learning experiences they wish to discuss in the interviews. They also are given the choice as to whether they wish to respond to questions.

The teacher involved in the study is a full-time classroom teacher and there are no anticipated risks on her position within the school or school district. There are no anticipated risks of promotion, retention or grades associated with students participating in the science class.

The potential benefit to the students and teacher will be that of gaining insight into the teaching practices in science education. The teacher can gain insight into teaching practices that may influence change in teaching practices, which may directly benefit STUDENTS.

9. Describe how participants will be recruited, the number and age of the participants, and proposed compensation (if any):

The population of the study will consist of students in the fourth and fifth grade (approximate ages 10-12) and their science teacher in [ ]

Elementary School. The teacher and students in this study were participants in a previous professional development project, Mathematics and Science Professional Development Project (MSPD) housed at the University of Central Florida during the years 2000-2003. During the MSPD Project, I provided professional development support to the teacher and students, and this experience provided a focus for this research study.

The teacher and students will be present at an orientation session describing the research (see Orientation Session-Verbal Overview of Research Study). After the information sessions on the details of the study, and students' and teacher's questions are addressed, the researcher will obtain written consent from all students, parents/guardians who are willing to participate. The consent forms will also ask participants for permission to tape record the interviews. Students' class work and the teacher's lesson plans will be collected and analyzed for emergent themes and patterns. (See attached consent form and survey.) Students from grades 4 & 5, regardless of age, gender, and race will be eligible to participate in the study. All students will be minors, therefore parental/guardian consent is required. The teacher is not a minor, nevertheless she will receive a consent form. The Orange County Public School District does not require district approval, even so, the principal will be provided with a consent form informing her of the research project (See attached consent form).
10. Describe the informed consent process: (include a copy of the informed consent document)

The students in grades 4 and 5 will have the opportunity to attend an orientation session (See Orientation Session- Verbal Overview of Research Study). This session will be planned by the classroom teacher and researcher. After the session describing the study, the students will have an opportunity to ask questions about the research. Once the students listen to the orientation session, and have their questions answered, the researcher will distribute the letter to obtain written parental/guardian consent. All fourth and fifth grade students and parents/guardians will be given a copy of the informed consent document that includes two copies of the cover letter with consent form. The parent/guardian will keep a copy of the informed consent letter describing the research project for their records. Parent/guardian who voluntarily agrees to allow their child to participate in the study will complete and return the second copy of the informed consent. Only students who voluntarily agree to participate will complete the study.

The teacher participant will be given a copy of the informed consent document (see attached) that includes two copies of the cover letter with consent form. The teacher participant will keep a copy of the informed consent letter describing the research project for her records.

The researcher will visit the principal prior to the student/teacher orientation to verbally explain the research project and answer questions. The principal will receive the informed consent documentation that includes two copies of the cover letter with consent form. The principal will keep one copy of the cover letter describing the research and the interview questions for her records and complete and return the other copy. I will also request that the principal use school letter head to confirm participation in this study.

I approve this protocol for submission to the UCFIRB.

[Signature]

Department Chair/Director

Date

Cooperating Department (if more than one Dept. involved).

[Signature]

Department Chair/Director

Date
APPENDIX B

Parent/Guardian Informed Consent Cover Letter
August 13, 2003

Dear Parent/Guardian,

Hi, my name is Ms Kim Dahl and I am a student at the University of Central Florida working with Dr. Larry Holt. Your child is being asked to be included in a research study on how students learn science in elementary school. The results of this study may help other teachers to understand how inquiry-based science teaching can facilitate students’ understanding of science concepts and processes.

Mrs. XXXXX, the science lab teacher, and I will be working together throughout the study. We will be working together planning, teaching, and analyzing the science concepts and processes in the classroom.

I would like to start with an interview of the students in science. These questions do not have right or wrong answers. There will be an interview at the start of the study, one interview during the middle of the study and one at then end of the study. Each interview will be about 15 minutes long. I will destroy the audio tapes once they have been transcribed. I would also like to make use of your child’s class work to further document my understanding the learning process as students experience science learning.

There are no expected risks, rewards, or other direct benefits to your child as they participate in this study. Participation in this research is voluntary and will not affect their grade. They will not have to answer any questions that they do not wish to answer and their responses will be kept confidential.
With your permission, I will audiotape the student interviews. The classroom teacher and I will have access to the tapes, which I will personally transcribe. The student work will be transcribed or described in the final paper; all identities will be coded to protect the identity of your child. Your child’s identity will be kept confidential and will not be revealed in the final paper. Students may discontinue their participation in the study at any time without consequence.

If you have questions about this study, please contact me at 386-668-5129, kdahlnor@aol.com, or send a note with your child. Or you may contact my faculty advisor, Dr. Larry Holt at 407-823-2015.

Please sign and return this letter, keeping a copy of this signed letter for your records. By signing this letter, you and your child give me permission to work with your child collecting data that will help me learn more about students’ learning about science. Thank you for your consideration.

Sincerely,
Kimberly Dahl

_____ I have read the procedure described above.

_____ I voluntarily agree to allow my child, ______________________________, to participate in the study.
_____ I do not wish to allow my child, ______________________________, to participate in the study.

_____ I would like to receive a copy of the final copy submitted to the doctoral committee

_____ I would not like to receive a copy of the final copy submitted to the doctoral committee

_______________________________________/______________
Parent/Guardian’s Signature            Date

_______________________________________/______________
Child’s Signature                      Date

_______________________________________/______________
Principal Investigator’s Signature      Date
APPENDIX C

Orientation Session- Verbal Assent of Research Study
Hello. My name is Ms. Dahl and I am a student at the University of Central Florida in the College of Education. I am working on a class project with my teacher, Dr. Holt. Our project is about this science learning. You are being asked to be included in a research study about how students learn science in elementary school. This study may help other teachers and students to understand how science teaching and learning can work in their classroom.

Your participation is anonymous, in other words, your real names will not be used in the study. I will not use any identifying information. You do not have to answer any question you do not wish to answer and you may stop your participation at any time without consequence. There is no expected danger or risk. Also, there won’t be any rewards or benefits from participating in the study.

I will ask some of you for an interview. These questions do not have right or wrong answers. There will be an interview at the start of the study, one interview during the middle of the study and one at the end of the study. Each interview will be about 15 minutes long.

I would also like to make use of your class work. For example, when you write about what you have learned in a science lesson.

I will ask you to bring home a letter to your parent or guardian. They will need to read it and sign it. I will ask you to bring back one copy for me to keep for my records, and your parent or guardian gets to keep one.
Unfortunately, I cannot pay you or give your rewards for your time, but your participation is greatly appreciated. If you have any questions about the study or what I am doing, please ask.

Thank you.
APPENDIX D

Student Interview Questions - First Set
The questions below will be used to interview a sample of students focused on student learning experiences in an inquiry-based science classroom. They do not have to respond to any question they do not wish to answer. Participation is not mandatory.

“Hello, my name is Ms Dahl. Thank you very much for allowing me to talk with you. I will be asking you some questions about your experiences in the science lab. I am going to audio record this interview so that I can focus on what you are saying. It will help me to remember what you said. You may stop at any time and you will not have to answer any questions you do not want to answer. Would you like to do this?

Before we start, do you have any questions of me? Ok, let’s start.”

1. What do scientists do?
2. Do you do any of those things?
3. What kinds of activities do you do in science?
4. Do you get a chance to ask questions?
5. If yes, what kinds of questions do you ask?
6. Do you get a chance to tell what you know about what you are studying in science?
7. How do scientist record what is happening?
8. How do you record what is happening in science?
9. Do you have a choice about what you want to learn in science?
10. If yes, tell me about those choices.
APPENDIX E

Student Interview Questions - Second Set
The questions below will be used to interview a sample of students focused on continued student learning experiences in an inquiry-based science classroom. The questions were developed from concepts established in the classroom. They do not have to respond to any question they do not wish to answer. Participation is not mandatory.

“Hello. Thank you very much for allowing me to talk with you again. I will be asking you some questions about your experiences in the science lab. I am going to audio record this interview so that I can focus on what you are saying. It will help me to remember what you said. You may stop at any time and you will not have to answer any questions you do not want to answer.

Would you like to do this?

Before we start, do you have any questions of me? Ok, let’s start.”

1. Tell me about magnets.

2. How do you know if something is magnetic?

3. How do you know if something is not magnetic?

4. What questions do you have about magnets?

5. How would you investigate that question?
APPENDIX F

Student Interview Questions - Third Set
The questions below will be used to interview a sample of students focused on continued student learning experiences in an inquiry-based science classroom. The questions were developed from concepts established in the classroom. They do not have to respond to any question they do not wish to answer. Participation is not mandatory.

“Hello. Thank you very much for allowing me to talk with you again, this will be the last one. I will be asking you some questions about your experiences in the science lab. I am going to audio record this interview so that I can focus on what you are saying. It will help me to remember what you said. You may stop at any time and you will not have to answer any questions you do not want to answer. Would you like to do this?

Before we start, do you have any questions of me? Ok, let’s start.”

1. Tell me about electricity.
2. How does it work?
3. What questions do you have about electricity?
4. How would you investigate that question? OR
5. What would you like to find out about electricity?
6. If you had a chance to pick what you wanted to learn about in science, what would you like to learn about?
7. How would you investigate or find out more about that topic?
APPENDIX G

Teacher Consent Cover Letter
July 1, 2003

Dear Mrs. XXXXX,

My name is Kimberly Dahl and I am a doctoral candidate at the University of Central Florida working under the supervision of faculty member Dr. Larry Holt. You and the XXXXX Elementary School students your science lab class are being asked to participate in research designed to study inquiry-based teaching and learning science in an elementary school setting. The results of this study may assist other teachers to understand how inquiry-based teaching science can work in their classroom.

Participation in this research involves providing me access to the XXXXX Elementary School science students and discussions with you about teaching and learning science through inquiry-based instruction. You will not have to answer any questions that you do not wish to answer. With your permission, I will audiotape the interviews. Only I will have access to the tape, which I will personally transcribe, removing identifiers during transcription. Audio tapes will be destroyed once they have been transcribed. Your identity will be kept confidential and your identity will not be revealed in the final transcript.

I would also like to use science lesson plans created during the research procedure. The lesson plans will be transcribed or described in the final paper; all identities will be coded to protect the identity of your identity. Your identity will be kept confidential and will not be revealed in the final paper.

There are no anticipated risks, compensation, or other direct benefits to you as you participate in this study. Participation in this research is voluntary. The identity of the students, teacher, and school will be kept confidential and the identities will not be revealed in the final transcript. You may depart from the study at any time without consequence.
If you have questions about this research project, please contact me at 386-668-5129 or kdahlnor@aol.com. Or you may contact my faculty advisor, Dr. Larry Holt at 407-823-2015. Questions or concerns about research participants’ rights may be directed to the UCFIRB office, University of Central Florida Office of Research, Orlando Tech Center, 12443 Research Parkway, Suite 207, Orlando, FL 32826. The phone number is 407-823-2901.

Please sign and return this letter, keeping a copy of this signed letter for your records. By signing this letter, you give me permission to work with you collecting data that will support the final manuscript as part of my doctoral work. Thank you for your consideration.

Sincerely,

Kimberly Dahl

_____ I have read the procedure described above.

_____ I voluntarily agree to participate in the procedure.

        _____ I would like to receive a copy of the final manuscript submitted to the doctoral committee

        _____ I would not like to receive a copy of the final manuscript submitted to the doctoral committee

_______________________________________/______________
Teacher’s Signature         Date

_______________________________________/______________
Principal Investigator’s Signature         Date
APPENDIX H

Teacher Interview Questions
“Please answer the following questions. You do not have to respond to any question you do not wish to answer. This interview will be audio tapped and I will transcribe the recording personally to provide accuracy.”

1. Describe the learning experiences in the science lab last year 2002-2003.
2. Describe the learning experiences that you have tentatively planned for the 2003-2004 school year.
3. What factors are included in the planning of your science lessons?
4. What factors are included in the design of your science lessons?
5. What do you think is the best way to teach science?
6. What do you think is the best way to teach science in your classroom?
7. What questions do you have for me?
APPENDIX I

School Consent Cover Letter
July 1, 2003

Dear Principal XXXXX,

My name is Kimberly Dahl and I am a doctoral candidate at the University of Central Florida working under the supervision of faculty member Dr. Larry Holt. XXX Elementary School students and teacher, Mrs. XXXXX are being asked to participate in research designed to study inquiry-based teaching and learning science in an elementary school setting. The results of this study may assist other teachers to understand how inquiry-based teaching science can work in their classroom.

Participation in this research involves providing me access to XXXXX Elementary School students in Mrs. XXXXX’s science lab classes.

There are no anticipated risks, compensation, or other direct benefits to XXXXX Elementary School students or Mrs. XXXXX as they participate in this study. Participation in this research is voluntary. The identity of the students, teacher, and school will be kept confidential and the identities will not be revealed in the final transcript. They may depart from the study at any time without consequence.

If you have questions about this research project, please contact me at 386-668-5129 or kdahlnor@aol.com. Or you may contact my faculty advisor, Dr. Larry Holt at 407-823-2015. Questions or concerns about research participants’ rights may be directed to the UCFIRB office, University of Central Florida Office of Research, Orlando Tech Center, 12443 Research Parkway, Suite 207, Orlando, FL 32826. The phone number is 407-823-2901.

Please sign and return this letter, keeping a copy of this signed letter for your records. By signing this letter, you give me permission to work with XXXXX Elementary School students and Mrs.
XXXXX, collecting data that will support the final manuscript as part of my doctoral work.

Thank you for your consideration.

Sincerely,

Kimberly Dahl

_____ I have read the procedure described above.

_____ I grant permission to contact the students and instructor and ask for their informed consent to participate in this study.

_______________________________________/______________
Principal’s Signature               Date

_______________________________________/______________
Principal Investigator’s Signature  Date
APPENDIX J

Worksheets
# Student Scientist:

## NAME THAT CHANGE!

<table>
<thead>
<tr>
<th>Station</th>
<th>Physical</th>
<th>Chemical</th>
<th>Both</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Ice Cube</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 Steel Wool in Vinegar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#3 Baking Soda and Vinegar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4 Apple Slice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#5 Burning Candle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#6 Salt and Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Science 4, Unit 3
9/2/2002
What Will A Magnet Attract?

Magnetic attraction is a force that makes some things move toward a magnet.

Of the objects listed below, which will a magnet attract?

Make your prediction. Record your results.

<table>
<thead>
<tr>
<th>Prediction</th>
<th>Object</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>thumbtacks</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>nail</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>toothpicks</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>penny</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>pin</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>sand</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>pen</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>bits of paper</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>paper clips</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>tin foil</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>dime</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>steel wool</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>leather</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>glass</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>tin can</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>cloth</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>scissors</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>brass paper fastener</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>rubber bands</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>needle</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>plastic</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>magnet</td>
<td>no</td>
</tr>
</tbody>
</table>

Conclusion: ________________________________
APPENDIX K

Foldings Examples
9/29/03

9/20 T
9/21 S

Teacher gets multiple questions about what tools scientists use.

Cells on students individually seen.

Some raise hands, some she calls on that are not paying attention.

She states what is going on.

After students get materials and figure out what to do.

Time after a student responds by talking with each other.

Give process whether it is the right.

\( \text{Obj. to learn} \)

- Someone raise hands, but are not called on.

- Students given directions, they only start to move before she finishes.

She raised her voice and tried to talk over them.

After students get materials and figure out what to do.

They start to work.

- Your name: 4th grade.

- Students copied statements in front of S.J.

- Discuss cut out.

- Students quit, raise hands, answers.

- Question: yes or no.

- Name of tools, Ten ask "What did you come to know about these tools?"

- Ask students to select a job, materials. print.
Students formed groups. Students gave a "right"
classification of animals. 1st. Students drew pictures.
Students wrote about their drawings.
I shared a new question to focus on in science based on my experiences.

What did you notice?

Students respond in journal asking question:

What did you notice about the water drops of water on the penny?

What did you notice about...?

2) Does the side of the penny make a difference?

Does it make a difference if the penny is wet or completely dry?

3) What happens if the drop splashes? Does that change the amount of water the penny can hold?

26.00
3.00
26.00 + bubble heads
26.00 + bubble tails

What happens if the penny is flipped?

Knowing how to use an eye dropper.

Many did not know how to use an eye dropper.

One student brought up the concept of surface tension.

One student brought up the concept of surface tension.

One new student wrote date plus question in science journal.

One new student explained the closest, book, teacher.
asks them to open it. (5) Teacher says work is
staply, ask student to do it
again.
Last year student did this
this year they are asked to
collect data similar to last.
You eat in addition what else is
typically about the water + solution variables.

Demos how to use
droppers.

Choose a material (pH test)

Wet the penny:
Some of you didn’t get
a chance to glue down sci
tools last week.

Clani - crumpled up paper towel
Wetting bubbles

Droplets onto penny

Now she wants to
Glue Sci tools into notebook.

That's sloppy. "Do you
want to write it good-
that is not writing like
a 4th grader."
Question

What will a magnet attract?

How do you know a magnet works?

Discuss the meaning of attracts.

Chalk comes to a time that they will no longer know what it is. (Records)

Predict whether the item will stick or not.

Discuss about IV, computer.

Turn worksheet after.

Write question.

Write answer.

1. What is a magnet?
2. A thing that attracts metal objects.

5. 5’s metal.
6. I don’t know.
7. Magnetism.
8. It’s metal.

I. What do I mean by magnet.
II. What makes it stick.
II. Iron needs to be magnetized by high voltage.

But when it sticks.

It’s electricity.

It’s electric??
Do you want it to be underlined?
No.
Let's look at the sheet and see what you remember from last year.

- 3 black girls -
  - The camera late, danced her way into the classroom
  - Was asked if that was an appropriate way to come into the classroom after
  - Walks over to me with a question for someone else.

Mrs. Lindsey talks with them about following directions to go through.
O - says she doesn't understand.
L - walks away.
Q - 1 - only
B - looking around seems uninvolved.
M + B - want to someone out in the hallway.
O - needs to go to RP.
B - Is the glass - holds up glass slide.

Magnetic.

When nobody what to do said she wasn't in the room. She came in last however she was here - she didn't hear the direction.
O - broke slide - I didn't mean to others B + M laughed.
Most of chart not filled in.
O - still standing.
Could not do double bubble map not the flexibly
APPENDIX L

Student Work Examples
Nov 21, 2003

1. What is a magnet? A magnet is something you use to make to stick together.
2. How can you make a magnet? With magnetic material. You can also make magnet out of iron.

I learned that magnets is one thing that you can make. I did not know that you can make magnet it is very cool. If you have a big magnet and you want a small one you can make one by only rubbing something that is not magnet with a magnet that is cool isn't it? If any one asks me I do I know that I will tell them that I learned it in the science lab with Ms. Dohle and Mrs.

I will like to learn more about magnets. The kind of thing I want to learn is how do magnet stick together.
And I learned iron filings can get attract by a magnet then what I learned today in science class and I wish I can learn a lot about what a magnet can attract.
I learn that a magnet could attract metal only if the stuff is not a metal it is not going to attract it. And I learn that the magnet don't stick to the sand it go through it.

I think the magnet is pulling the black stuff only not the sand because sand don't have metal on it.
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Janesick, V. (2000). The choreography of qualitative research design: Minuets, improvisations,


Schwab, J. (1978). *Science, curriculum, and liberal education.* Chicago, IL: The University of


