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The primary purpose of this action research study was to explore an elementary science program and find ways to support science education as an administrator of an elementary school. The study took place in a large suburban school system in the southeastern United States. Seven teachers at a small rural school volunteered to participate in the study. Each participant became an active member of the research by determining what changes needed to take place and implementing the lessons in science. The study was also focused on teacher collaboration and how it influenced the science instruction. The data collected included two interviews, ten observations of science lessons, the implementation of four science units, and informal notes from planning sessions over a five month period. The questions that guided this study focused on how teachers prepare to teach science through active learning and how instruction shifts due to teacher collaboration.

Teachers were interviewed at the beginning of the study to gain the perceptions of the participants in the areas of (a) planning, (b) active learning, (c) collaboration, and (d) teaching science lessons. The teachers and principal then formed a research team that determined the barriers to teaching science according to the Standards, designed units of study using active learning strategies, and worked collaboratively to implement the units of study.

The action research project reviewed the National Science Education Standards, the theory of constructivism, active learning and teacher collaboration as they relate to the actions taken by a group of teachers in an elementary school. The evidence from this study showed that by working together collaboratively and overcoming the barriers to teaching science actively, teachers feel more confident and knowledgeable about teaching the concepts.

TEACHER COLLABORATION AND ELEMENTARY SCIENCE TEACHING: USING ACTION RESEARCH AS A TOOL FOR INSTRUCTIONAL LEADERSHIP

By

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Dedicated in memory of Dr. Rebecca Carver

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

Building communities of learners engaged in professional service to student learning is an expectation for an instructional leader in an elementary school. Instructional leaders need to find ways to build these communities. Action research in an elementary school that is focused on the improvement of student learning is one way. This is a study of how a group of teachers worked together to help improve their teaching practices in science at an elementary school. In this introduction, I provide background and history about the standards for teaching science as well as the rationale for research on this topic.

Background

During the eighties and nineties, the quality of science instruction that American public school elementary students were receiving became a serious concern of educators (Carnegie Forum on Education and the Economy, 1986). Studies on how science was taught in schools left no question that change was necessary (Manning, Esler, & Baird, 1982). By 1996, the *National Science Education Standards* (National Research Council) outlined what teachers of science at all grade levels should know and be able to do as well as provide a vision for the development of professional knowledge and skills among teachers.

The *National Science Education Standards* had several important precursors including the publication in 1983 of *A Nation at Risk* by the National

Commission on Excellence in Education and the publication of *Project 2061* by the American Academy for the Advancement of Science in 1989. Current reform efforts in science education have their roots in these reports (Gardner & Others, 1983). A *Nation at Risk* was critical of education in the United States and raised concerns that national student achievement across core subjects was eroding. These core subjects were reading, math, and science. In response to *A Nation at Risk*, President George H. W. Bush called a National Education Summit in 1989. This summit ended with the establishment of broad goals for education. To meet these goals by 2000, another report, *Building a Nation of Learners*, focused on results, sustaining reform, launching academic standards, supplying data so states could monitor progress, and advocating for educational improvement. The National Research Council was charged to form academic standards to address the needs mentioned in this report. Published in 1996, the *National Science Education Standards* provided a framework for science education. Twenty-eight standards were developed that encompassed teaching, professional development, content, science education programs and system standards. These standards required major changes in the way science had been taught. They rest on the premise that science is an active process. "Learning science is something that students do, not something that is done to them" (National Research Council, 1996).

The No Child Left Behind (NCLB) Act became law in 2002. The NCLB Act mandated that reading and math assessments be implemented in 2003 forcing

many states to focus on reading and math proficiency thereby pushing all other subjects aside. This focus by state departments of instruction caused many teachers not to teach science according to the *National Science Education Standards*. "This relative lack of impact undoubtedly reflects the low priority given to science at all levels of American education; science often gets pushed to the bottom of the curricular agenda, while worries about reading, writing, and math gobble up time, attention, funding, and energy for staff development and curriculum reform" (Zemelman et al., 1998, p. 6). However, the NCLB Act required challenging content standards for science to be in place by the 2005-2006 school year. Also, beginning in the 2007-2008 school year, all states must administer science assessments at least once in Grades 3-5, 6-9, and 10-12. Ultimately, the law mandates that all students must achieve at proficiency level in all subjects by the 2014-2015 school year.

In response to NCLB mandates, states have now written their own science standards using the *National Science Education Standards* as a guide. The state in which the study was conducted revised the Standard Course of Study (SCS) science component to align with the *National Science Education Standards* and connect with the *Benchmarks for Scientific Literacy*. SCS was "created to establish competency goals and objectives for teaching and learning science in all grades" (North Carolina Department of Public Instruction, 2004). Each component of the SCS details the concepts, theories, skills and processes for science instruction. The Standard Course of Study (SCS) is broken down into

elementary and secondary curricula. For the secondary curriculum to be successful, the elementary program has to achieve early success because the program sequentially builds upon prior student learning across the standards continuum. Each SCS section integrates "the unifying concepts of science to provide continuity in science instruction across grade levels and between disciplines" (North Carolina Department of Public Instruction, 2004). This integration causes the entire elementary school science program to be responsible for teaching science according to SCS, not just the grade level that is tested in a given year, since the SCS is a construction of learning throughout many years. In 2007-2008, fifth grade students will be required to be proficient in science according to an End-of-Grade assessment.

Focus and Rationale

This topic is of particular interest to me since I am a former science teacher and now an elementary school principal. I have witnessed elementary classroom teachers relying on textbooks and worksheets to teach science instead of using manipulatives and experiments. I wanted to know what was causing teachers not to teach according to the *National Science Education Standards*. I also wanted to learn their views on how they could gain the skills to teach by the expectations of the Standards. As a school administrator, I am concerned about how our students can pass the 2007-2008 science competency test, designed around the Standards. I have observed elementary teachers using passive teaching strategies in their science instruction. Additionally, I

wanted to find out how administrators can support teachers to teach science according to the national and state standards.

I strongly believe schools must find ways to support elementary science teachers in engaging their students by employing active and meaningful methods of science teaching. In order to gain this information, I designed my study as an action research project. The research team consisted of seven teachers and me working together to discuss, research, and study this problem. As a team, we first collaborated on what were the barriers to teaching science in elementary schools. Next, we designed a way to overcome the barriers and, finally, we studied how we developed and improved our practice. Teachers had the opportunity to cultivate and nourish their students' innate curiosity about the world through their science teaching. The team also had the opportunity to explore various teaching methods and active learning strategies for science instruction. This type of study was very effective and important at my school due to my school's small size and the leadership skills of the team members. Because I researched my own school, I was able, as principal, to join the team and discuss instructional issues as well as share our findings throughout the study with non-participating staff members. Through opportunities for teacher leadership, the team members and I built the capacity within the school to promote active teaching methods and shift instructional practices.

My study took place in a small, rural school where science was traditionally taught by completing each chapter in the textbook series. I

discovered the equipment and materials in the supply closet had rarely been used during the past five years. I felt this site was an excellent location to gather research data because, in fact, my teachers were not teaching according to the Standards. However, many teachers had discussed how they wanted to become more active science teachers. This study only explored science teaching; however, all of the teaching methods could be applied to any subject being taught since active learning is not just a strategy to teach science.

As an action research study team, the teachers and I were involved in exploring the collaboration efforts of the team and its effects on teaching practices. The research focused on the interactions among the team of teachers who were focusing on the teaching of science. Thus, this study explored the following questions:

(1) How does teacher collaboration influence teacher preparation for active learning in science?

(2) What strategies do elementary teachers currently use to teach science?

(3) How do elementary teachers prepare for teaching a lesson in science?

(4) How has teacher collaboration shifted the instructional paradigm?

An underlying theme was to explore how action research can be used as a tool for enhancing my instructional leadership.

Definitions

Within the context of this study, the following definitions were used:

Constructivist Theory: The term refers to the theory that students create their own knowledge through their own experiences while teachers act as facilitators and guides. During my literature review, this theory and how it became the basis of understanding of the *National Science Education Standards* will be explained more thoroughly.

Active Learning: The term refers to methods of teaching that require students to be actively engaged in their own learning. It can be generalized to include hands-on learning, cooperative learning, minds-on learning, experiential learning, group work and much more. It is further described in Chapter II.

Teacher Collaboration: The term describes how teachers work together professionally with the purpose of supporting the teaching and learning of students. This term is one of the avenues the research team used to develop and strengthen their instructional practices.

Action Research: The term describes research that creates action to take place that then allows a researcher to study the outcomes from the action.

Assumptions

Based on my experiences as a science teacher and a school administrator, I assume that teachers want to teach in ways that students will learn the most. However, because many teachers do not have the resources or knowledge to feel confident teaching science actively, they rely on the textbook

for ideas. As a researcher, I had to remember that this assumption is important to prevent my bias as a former science educator from influencing my views during observations and interactions with the team. However, my experience as a science teacher also allowed more contributions to the planning sessions as part of the action research team. This assumption is important for the reader to know since I am familiar with the content and the school that is studied.

Limitations

This study was limited to one small public school with twelve classroom teachers where the action research took place. Seven teachers volunteered to participate and explore their own teaching of science. The participants engaged in interviews, observations, and planning sessions resulted in their working together to plan units of study. The duration of the study was five months. Yin (1994) states that having a limited number of cases is valid if data sources are triangulated and the inquiry has sufficient depth. My study met this condition because I collected various kinds of data (e.g., teacher interviews, classroom observations, collection of lesson plans and artifacts, and informal conversation) and I conducted an intensive action research study focused on the research questions. I involved the participants in the research study after the first set of interviews. The team evaluated the data collected from the interviews to determine the next action step to take. The team conducted planning sessions and demonstration lessons for each other throughout the study.

Organization

In Chapter II, the reader will find my review of the pertinent literature surrounding the following themes: constructivist theory, science education, teacher collaboration, and active learning. I explored these themes in the literature due to the powerful role they have in the *National Science Education Standards*. I also used the standards to frame the conceptual framework for the research study. I used this framework to analyze the data across each of the cases.

Chapter III details my research methodology. This study was an action research conducted at the school where I was the principal. The participants in the study volunteered to participate in interviews, observations, and informal conversations to affect change in the science education methods they currently used. Chapter IV provides a description of each case studied in the research. The final chapter contains an analysis of the data and reveals how the participants' views changed over time and how the science instruction shifted due to teacher collaboration. It also incorporates my findings and implications for further research.

During the K-5 school years, scientific literacy depends on children's early engagement in science. The federal government is requiring all students to demonstrate proficient science literacy by 2007-2008 school year. By highly engaging a team of teachers with science education, my study investigates the collaboration between the team and its influence over changes in instructional

practice. As an elementary principal, I need to know how to support teachers to be able to educate our students in science.

I believe one of the most important roles of an elementary principal's job is to ensure student learning. Since achievement in learning is guided by state and national standards, I must attempt to create a workplace where such standards can be attained through effective teaching. Therefore, I must know what obstacles prevent my teachers from educating their students according to established standards and what strategies I need to put in place in order for my teachers to apply best practices in their science teaching. My research addresses the influence of collaboration on the teaching in the school through the use of action research.

CHAPTER II

REVIEW OF LITERATURE

This chapter contains my review of the literature surrounding the theory of constructivism, science teaching and learning, active learning, and teacher collaboration. All of these topics are important to my research study since the reader must understand what each means in order to apply and understand the study. At the end of this chapter, I explain the conceptual framework for my study.

Constructivist Theory

Constructivism is the belief "that children do not just receive content; in a very real sense, they recreate and reinvent every cognitive system they encounter, including language, literacy, and mathematics" (Zelmelman, Daniels, & Hyde, 1998, p. 8). Many educational theorists such as Piaget, Dewey, Bandura, Duckworth, Bruner, Schwab, Kohlberg, and Papert referred to constructivism or some methodological form of this philosophy when they discussed best practices in science teaching. Piaget's early interests and the constructivist methodology that is ascribed to him link to science in both teaching and learning (Howe, 1996; Wandersee, Mintzes, &Novak, 1994).

In the constructivist approach (Bruner (1966), Piaget (1954), Vygotsky (1981), the role of the classroom teacher is primarily to "facilitate and guide" and to provide a variety of resources and differentiated activities to keep the students

"on task and active" in the learning process. Classroom teachers should focus on making connections between facts and fostering new understanding in students by encouraging students to use their critical thinking skills. This approach encourages students to generate their learning based on a framework of discussion and discovery in concert with other learners. Learning occurs more by active engagement with materials and creating new connections between pieces of data rather than by passively receiving a continuous stream of facts and other information.

> A constructivist takes the position that the learner must have experience with hypothesizing and predicting, manipulating objects, posing questions, researching answers, imagining, investigating, and inventing, in order for new constructions to be developed. From this perspective, the teacher cannot insure that learners acquire knowledge just by having the teacher dispense it; a learner-centered, active instructional model is mandated. The learner must construct knowledge; the teacher serves as creative mediator of the process. (Fosnot, 1989, p. 20)

Constructivism (von Glasserfeld, 1989) implies that, as teachers engage in learning which may lead to change, new ideas and experiences are interpreted and tested for viability in terms of what is already understood about teaching and what works in the social and cultural surroundings of the educational community. Any change in the implemented curriculum will fit the teacher's understanding of what makes sense in a given framework (Briscoe, 1991; Tobin, 1993). Constructivism is a philosophical approach to learning that states that students construct their own knowledge from previous experiences and further

happenings with which their teachers and others present them. Hands-on activities, manipulatives, problem-based learning, use of the learning cycle and inquiry-based learning are methods that aid the constructivist perspective (Jones, 1996). The understanding of theory of constructivism is crucial to the implementation of the research study on improving science education in an elementary school. My study takes the research team through the construction of their own knowledge and experiences in collaboration to create a change in the way they teach science.

Science Teaching and Learning

Effective teaching is the core of Science Education. Effective science teachers create an active learning community where they and the students work together to learn. Teachers must have knowledge and abilities about science, learning and teaching in order to teach science according to the Standards. They must also collaborate with colleagues to expand their knowledge of content about science teaching.

In *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993) what students should be able to do and what they should know at each opportunity in their educational career are orchestrated. Where the *Standards* are the compass, the *Benchmarks* are the exit ramps on the highway. Each standard gives a direction to teach with each one giving more details of how to get there.

The *Standards* are focused on only science. Zemelman et al. (1998), author of *Best Practice,* brought together in one report what various leaders were attempting to do in producing standards for their disciplines. He found that the authors of these documents had remarkably similar stands when compared to each other, "We found… all the authoritative voices in each field are calling for schools that are student-centered, active, experiential, democratic, collaborative, and yet rigorous and challenging" (Zemelman et al., 1998, p. xx).

The *National Science Education Standards(1996)* state that Science teaching expect that:

(1) teachers of science plan an inquiry-based science program for their students;

(2) teachers of science guide and facilitate learning;

(3) teachers of science engage in ongoing assessment of their teaching and of student learning;

(4) teachers of science design and manage learning environments that provide students with the time, space and resources needed for learning science;

(5) teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning; and

(6) teachers of science actively participate in the ongoing planning and development of the school science program.

Zemelman et al. (1998) cites thirteen principles supporting the paradigm shift to the best practice of learning which therefore impact teaching. They see learning as: (1) student-centered; (2) experiential; (3) holistic; (4) authentic; (5) expressive; (6) reflective; (7) social; (8) collaborative; (9) democratic; (10) cognitive; (11) developmental; (12) constructivist; and (13) challenging. Comparing the thirteen principles of learning that Zemelman et al. (1998) propose to the six standards of teaching in the *National Science Education Standards*, it appears that any one standard could embrace all thirteen learning principles.

The National Science Standards are grounded in the following assumptions for science teaching:

(1) What is learned is influenced by how they (teachers) were taught.

While teachers might not be expected to have a degree in science, the lack of academic concentration in science by teachers could be of some concern because research has shown that without the essential base of subject matter knowledge, teachers could be unable to instruct effectively (Grossman, Wilson & Shulman 1989). Research has also shown that, if teachers possess both subject matter expertise and the ability to present that subject matter to students, they are more likely to engage in activities that facilitate student learning (Tobin & Fraser, 1990). All teachers have beliefs about science, learning, and teaching. They can be implicitly and explicitly portrayed through their choices of teaching methods.

(2) Knowledge of science influence the actions of teachers.

The 2000 National Survey of Science and Mathematics Education found that substantial portions of elementary teachers believe that they are not well qualified to teach science. Seventy-five percent of the elementary teachers surveyed said they are "very well qualified" to teach language arts/reading, and 60% felt "qualified" to teach mathematics, but only about 25% think they are "very well qualified" to teach science. The elementary teachers were also asked to rate their confidence in their preparation in different science disciplines. Only 29% of the teachers considered themselves "very well qualified" to teach life science, 25% rated themselves 'very well qualified' to teach earth science, and only 18% considered themselves 'very well qualified' to teach physical science. The same survey also reports that the amount of time spent on K-6 reading dwarfs science instruction. In self-contained classes in grades 4-6, the average time spent teaching reading/language arts was 96 minutes and only 31 minutes for science (Weiss, Banilower, McMahon, & Smith, 2001).

Research shows that, if teachers do not feel adequately prepared in a particular subject area such as science, they could neglect this subject and focus on other academic areas in which they feel more comfortable (Brophy, 1991). This finding is of particular concern at the elementary school level, where most students are taught in self-contained classrooms and remain with the same teacher for most academic subjects. With the addition of being a reflective practitioner, Coble and Koballa, Jr. (1994) believe that teachers who teach

science should possess science content knowledge; knowledge of science concepts; knowledge of the scientific enterprise; knowledge of the history of science; knowledge of science themes; knowledge of how students learn—theories about cognition and learning styles; knowledge of curricula; and content knowledge.

(3) Student understanding is actively constructed through individual and social processes.

Krueger and Sutton (2001) summarize several strategies for addressing standards in science instruction. Those recommendations include the following:

- Less emphasis on (1) knowing scientific facts and information; (2) studying subject matter disciplines for their own sake; (3) separating science knowledge and science process; (4) covering many science topics; and (5) implementing inquiry as a set of processes.
- More emphasis on: (1) understanding scientific concepts and developing abilities of inquiry; (2) learning subject matter disciplines in the context of inquiry, technology, science in personal and social perspectives, and history and nature of science; (3) integrating all aspects of science and content; (4) studying a few fundamental science concepts; and (5) implementing inquiry as instructional strategies, abilities, and ideas to be learned.

(4) Actions of teachers are deeply influenced by their understanding of and relationships with students.

The successful and dynamic classroom exists on the edge of order and chaos. If a room is too ordered, neat, planned, and predictable; independent learning and creativity can be stifled. On the other hand, a chaotic and completely unpredictable classroom does not allow much to be accomplished at all. Many things beyond what teachers plan for their classes influence what students learn in school. Students' attitudes, the interest and involvement of parents, and school climate all can affect teaching and learning both positively and negatively, although it would be inadvisable to assume a causal connection between any single variable and a student's performance (O'Sullivan & Weiss, 1999). The theory of complexity states that systems have acquired the ability to bring order and chaos into a special kind of balance (Waldrop, 1992).

Woodbury (1995) studied six exemplary elementary school teachers from six different schools. He found that teachers, who were teaching science as a non-preferred subject exhibited anxiety about their knowledge of science, relied on the science textbook and kept strict control of the classroom. The teacher who preferred teaching science taught with manipulatives and did experiments often. They also connected science to the lives of the students using a student-centered focus. They showed confidence in their teaching and allowed more student movement.

(5) It requires changes throughout the entire system.

Studies have shown an improvement in elementary teacher's attitudes toward science teaching if they receive professional development on how to

teach science and use equipment (Rubino, 1994). In an in-service where elementary school teachers were involved in learning how to use science kits, 96% reported better attitudes toward science and science teaching as a direct result of the workshops and the use of kits for science activities. In previous work, Bethel and Hord (1982), DeGroote (1972), and Hall (1990) have found that teachers who have attended science in-services indicate a change in science attitude following the in-service. Bitner (1990) found that teachers, who participated in science in-service activities, showed a reduced apprehension toward using science equipment.

These assumptions by the National Research Council create the background needed to understand the standards. Researchers in science education must expect that most elementary teachers have a limited knowledge of science due to the requirements of their collegiate education and the way they were taught science as a youngster. Most elementary teachers do not feel qualified to teach science.

Active Learning

Active learning shifts the focus from the teacher and delivery of course content to the student and his/her active engagement with the material. Through active learning techniques and modeling by the teacher, students discard the traditional role as passive learner and practice how to apprehend knowledge and skills to use them meaningfully. Meyers & Jones (1993) suggest that active learning involves providing opportunities for students to meaningfully talk and

listen, write, read, and reflect on the content, ideas, issues, and concerns of an academic subject. Active learning takes many forms. It can be experiential based, hands-on inquiry, manipulation of objects, role play, and commonly-cooperative learning. Experiential learning, inquiry-based learning, hands-on learning, and cooperative learning are the forms that are described. During my review of literature on active learning, these forms were the most commonly used in science lessons.

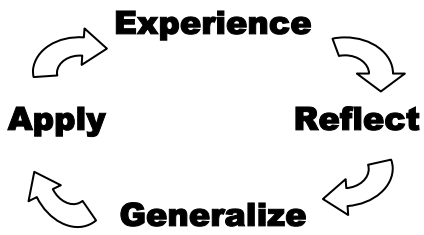
Experiential Learning

Seeing children actively engaged and manipulating a concept makes a difference in the retention and application of the concepts. Based on the works of John Dewey, Kurt Hahn and David Kolb, experiential learning involves an engagement into structured experiences, combined with meaningful reflection, as a way to maximize learning. These experiences can be anything from classroom problem solving activities to outdoor challenge courses and service learning projects. The experiences are combined with guided reflective practices. This helps students explore what happened during the experience, analyze the relationships that emerged, and connect the learning to another environment such as home (Carver, 1996).

Dewey (1938) asserts that it is the teacher's responsibility to structure and organize a series of experiences which positively influence each individual's potential future experiences. Basically, experiences that motivate, encourage,

and enable students allow them to go on to have more valuable learning experiences (Carver, 1996).

Figure 1: Kolb's Experiential Learning Cycle



When discussing experiential learning, one must explore the learning cycle that each experience must contain in order for the learning to take place. The initial stage of the learning cycle maintains the involvement in a structured experience. Often times this may be associated with games, fun activities or manipulation of objects. This is the doing part of experiential learning. The second stage of the learning cycle consists of participants sharing their feelings, reactions, and observations during the experience. The reflecting part is to make it known how each individual was progressing in the experience. The next stage is to process the shared ideas of the participants and reconstruct the patterns from the activity. The "generalizing" phase is the most abstract part of the experience when the participants must infer the experience into what lesson they learned. The facilitator (teacher) tries to help the students take the experience to the next level of application. The final phase in the Experiential Learning Cycle is to apply the experience to the content or to plan more effective behaviors for the

next experience. This cycle can empower teachers with students by integrating the curriculum with the experiences. The connections for teachers to learning experiences are the sharing of ideas and the reflection after the lesson has taken place.

Inquiry-based Learning

Science inquiry is defined by the authors of the *National Science Education Standards* as:

> 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 their results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. Students will engage in selected aspects of inquiry as they learn the scientific way of knowing the natural world, but they also should develop the capacity to conduct complete inquiries. (National Research Council, 1996, p. 23)

Students should be operating at Piaget's formal level of cognitive development to engage in scientific inquiry, because such inquiry requires among other things the manipulation of variables and the posing of a question to be answered by conducting an experiment. Others believe that with the proper guidance, students at various stages of cognitive development can manage scientific inquiry and can benefit from the exposure to the science process skills and research involved (National Research Council, 1996; Sarow, 2001).

Learning science through inquiry-based teaching methods allows students to gain first hand experiences in doing science and developing inquiry skills, such as the ability to: (1) identify and define a problem; (2) formulate a hypothesis; (3) design an experiment and (4) collect, analyze, and interpret data (National Research Council, 1996).

Inquiry-based science teaching and learning is supported by the *National Science Education Standards* (1996); *Science for All Americans: Project 2061* (1989); *Benchmarks for Science Literacy* (1993) and *Best Practice: New Standards for Teaching and learning in America's Schools* (1998). Inquiry-based teaching and learning is one of the many methodologies associated with the theory of constructivism. Recent reform and research in the way students learn in general, and learn science in particular, stresses constructivist learning.

Hands-On Learning

One of the most common phrases in education, hands-on learning is referred to in many instructional methods as "learning by doing." It literally means to manipulate the things studied and handle the tools of the activity. Elementary teachers have been interested for a long time in the use of manipulatives to provide concrete learning experiences in math (Ross &Kurtz, 1993). Hands-on teaching can be differentiated from lectures and demonstrations by the central criteria that students interact with materials to make observations and are involved in the learning. John Dewey "emphasized the same ideas about learning through activity and child-centered instruction

advocated during the eighteenth and nineteenth century by Pestalozzi and Froebel. The most representative feature of Dewey's philosophy of education was his recommendation of the project method of learning described by various followers as a purposive, problem-solving activity carried on it its natural setting" (Smith, 1979, p. 187).

Educational research has shown many advantages of using hands-on science programs. Bredderman (1982) reports the results of 15 years of research on activity-based science programs. This research was based on approximately 57 studies involving 13,000 students in 1,000 classrooms. All of the studies compared activity-based programs with comparable classrooms using a traditional or textbook approach for science teaching. The most dramatic differences were found in science process skills where the students in activity-based programs performed 20 percentile units higher than the comparison groups. The process skills included measuring, observing, investigating and other inquiry activities. The students in the activity-based programs scored higher in creativity, attitude, perception, logic development, language development, science content, and mathematics. The study also revealed that students who were disadvantaged economically or academically gained the most from the activity-based programs.

Cooperative Learning

To boost academic performance, many educators have turned to strategies of cooperative learning (Slavin, 1984). Cooperative learning

challenges students, together with peers, to use information in new ways and to create new understanding. It exists when groups of students work together to achieve combined learning outcomes (Johnson & Johnson, 1992). Studies among elementary schools, have shown cooperative learning facilitates learning and performance in the physical sciences (Chun-Yen & Song-Ling, 1999). In these studies cooperative learning also has produced higher student performance achievement and motivational outcomes than do the more traditional classroom learning strategies.

The research on the effectiveness of cooperative learning has been extensive (Educational Research Service, 1989, Wade, Abrami, Poulsen, & Chambers, 1995). It provides an alternative to competitive or individualistic classroom activities by encouraging collaboration among students in small groups. Cooperative learning restructures classroom activities and roles: students learn in multiple groups, teachers shift from transmitters of information to facilitators, and students become group participants and decision makers. The deflection of responsibility from the teacher to the pupil encourages peer-led discussions whereby students begin to construct their knowledge in accordance with their prior experiences and knowledge (Perkins, 1999). Cohen (1994) emphasized the importance of group interaction and the necessity of students being allowed to make mistakes and to struggle on their own, without excessive teacher supervision and interference.

Why not teach using Active Learning?

Given the large amount and consistency of supportive research that presently exists, I had to question why teachers are not using more active and collaborative teaching strategies. One answer I theorized was that few of today's classroom teachers have had extensive elementary preparation or in service professional development in using active learning formats; therefore, they do not know how to structure the learning. Another theory is that when teachers have tried this type of teaching, they were removed from their comfort zones to such a degree that they fell back into more familiar teaching and learning routines.

All active learning techniques are intended to help learners make relevant connections among course materials by transforming course materials from vague language or ideas into something learners can integrate into their own skill set and knowledge bank. Instructors may, however, find that students just do not fit their style of teaching or that others would work well in their classroom with modifications. In fact, some instructors may find that many activities they have done or currently do in class need only be influenced by active learning principles to become active learning techniques.

Teacher Collaboration

Change involves restructuring fundamental beliefs and ideas that teachers have about what is important for students to learn and how materials and methods may be used so that learning is achieved (Fullan, 2001). Investigations of how collaboration among teachers influences the development of individual

teachers as they implement change suggests that interaction among teachers is primary in facilitating the change process. Fullan (2001) argues that when teachers are able to interact with one another, change is facilitated. Collaboration increases teachers' ability to analyze and improve classroom practice and is a factor in increased job satisfaction.

Professional learning and development offers teachers the opportunity to learn new knowledge and skills but does not always guarantee that any given individual will change practice. The learning enhances the point of view one brings to a dialogue or conversation towards collaboration. The development extends beyond the training when it leads to collaboration of teachers in the form of speaking powerfully about their interest and listening in a committed way. Ultimately, this brings about change in knowledge, skills and/or attitudes. A commitment to making significant and lasting changes for the benefit of the whole community is a result of having a professional community.

Wenger (1998) defined a community of practice as "a collective learning that results in practices that reflect both the pursuit of our enterprise and the attendant social relations… a kind of community created over time by the sustained pursuit of a shared enterprise" (p. 45). Wenger also makes a case for the social nature of learning, even though "our institutions … are largely based on the assumption that learning is an individual process" (p. 3). The classroom community is one which is defined by the participants working together as they develop a shared vision. This community "includes routines, words, tools, ways

of doing things, stories, gestures, symbols… actions, or concepts that the community has produced or adopted in the course of its existence, and which have become part of its practice" (Wenger, 1998, p. 83).

Briscoe and Peters (1997) conducted a study involving a summer workshop series that followed teacher collaboration linked throughout the school year after the summer workshop. The workshop focused on elementary teachers learning problem centered teaching in science lessons. This study revealed that the collaboration between teachers beyond the workshop meetings was not as successful unless they were structured. The study coordinated, when possible, at least two workshop teachers from each participating school in the collaborations. A challenge arose when a teacher would move schools, grade levels, and/or remove themselves from the study. This caused the collaboration community to dissolve.

A professional learning community consists of a group of people who take an active, reflective, collaborative, learning-oriented, and growth–promoting approach toward the mysteries, the problems, and perplexities of teaching and learning. This learning community consists of five core characteristics: (1) It shares basic beliefs and values about students, learning and teaching. (2) It processes with reflective dialogue about teaching practices and student learning. (3) It develops deprivatization of educational practice through open discussion and problem solving. (4) It collectively focuses on student learning which drives

decision-making. (5) It ensures that collaboration exists across grade level and departments within the community (Hord, 1997).

The purpose of this professional learning community is to develop a deeper understanding of academic content and a support network for the implementation of curriculum and instructional initiatives. It also integrates and gives coherence to a school's instructional programs and practices while identifying what are the school-wide needs. Through the professional trust that is built in a professional learning community a school can build on existing expertise within the community and pool its resources. This provides moral support which creates a climate of trust that can confront problems and celebrate successes. Consequently, the empowered school community can deal with complex and unanticipated problems within its collaborative framework.

As Briscoe and Peters (1997) summarized in their study about teacher collaboration and the teaching of science using problem-centered lessons, the activities teachers planned caused them to develop new ways of managing their classrooms, time, and materials leaving them the ability to interact with students. The researchers discovered three assumptions about how collaboration influenced the change in teaching: (1) Brainstorming about content provided valuable preparation and confidence for participants. (2) Reflecting with colleagues on a lesson's pros and cons created a network of other educators who would also share successes and failures about their teaching. (3) The structured meetings, outside the work week, provided participants a reflective

and consistently supportive peer group that encouraged continued application of these new teaching methods.

Framework for this Study

I used the National Science Education Standards (National Research Council, 1996) to provide the framework that supports my study. It frames the study and provides a reference point for the questions that guide the investigation and also provides a framework for appraising the participants' capability in science teaching.

The standards address science teaching, professional development and standards for science education programs in schools, all three of which are evaluated in my research study. There are three other areas addressed in the standards but not in this study: science content, science assessment, and standards for science education systems. The passages below describe the standards that are pertinent to this study.

> The science teaching standards describe what teachers of science at all grade levels should know and be able to do. They are divided into six areas:
>
> - The planning of inquiry-based science programs.
> - The actions taken to guide and facilitate student learning.
> - The assessments made of teaching and student learning.
> - The development of environments that enable students to learn science.
> - The creation of communities of science learners.
> - The planning and development of the school science program.

> The professional development standards present a vision for the development of professional knowledge and skill among teachers. They focus on four areas:
>
> - The learning of science content through inquiry.
> - The integration of knowledge about science with knowledge about learning, pedagogy, and students.

- The development of the understanding and ability for lifelong learning.
- The coherence and integration of professional development programs.

The science education program standards describe the conditions necessary for quality school science programs. They focus on six areas:

- The consistency of the science program with the other standards and across grade levels.
- The inclusion of all content standards in a variety of curricula that are developmentally appropriate, interesting, relevant to students.
- The coordination of the science program with mathematics education.
- The provision of appropriate and sufficient resources to all students.
- The provision of equitable opportunities for all students to learn the standards.
- The development of communities that encourage, support and sustain teachers.

(National Research Council, 1996, pp. 4-6)

The National Science Education Standards (1996) provide me the most logical framework for answering the research questions that I posed for this study. They address not only science teaching, but also active learning and teacher collaboration to enhance the learning of students.

Figure 2: Conceptual Framework

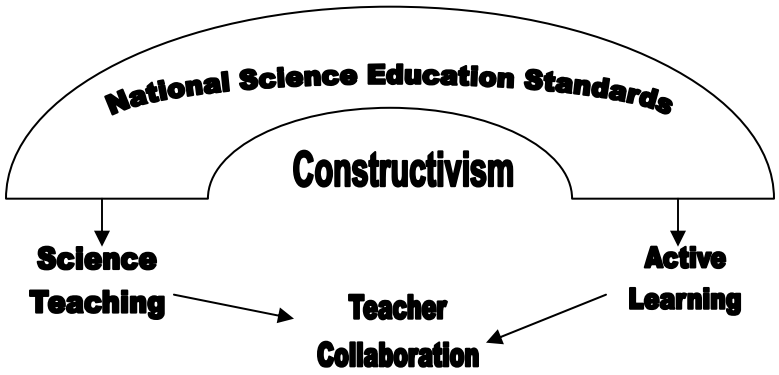


Figure 2 looks like an umbrella to reveal the importance of each part of the conceptual framework. The National Science Education Standards, as seen above, is the over arching piece of the framework. Conceptually, constructivism is the basis for the standards. Each section that is branching from the standards is a method explored in my research.

The Science Teaching Standards focus on a student-centered classroom in which children are active inquirers. They emphasize planning lessons, activities and experiences that focus on children's natural interest and motivations. Children are encouraged to work together to identify and solve problems, rather than passively and individually acquiring information. Teachers are encouraged to work with parents, the community, and other teachers to develop quality science lessons that permit children to think about the world around them and to critically analyze their choices and the impact their choices have on their life.

These standards also inform teachers of how a classroom would promote the vision of science literacy for all. One would see children clustered in groups, actively engaged in materials and with each other. The classrooms would be rich with natural phenomena (such as sticks, nests, fish, pets, etc.) that children can use to explore and inquire. They would plan their activities around relevant and meaningful scientific themes. Children would have access to a wide variety of equipment and materials allowing them to interact with the natural world. These inquiry tools and equipment may include magnifying lenses, balances, string,

balloons, rocks, clay, water, and a variety of measuring instruments and much more. The experiences for children also would be rooted in daily life and the teacher would act as the facilitator of group activities. The teacher would create a learning environment to heighten children's awareness of their surroundings, as they developed skills that would enable them to explore using scientific process skills.

The conceptual framework of my research study encounters this interpretation of the Science Teaching Standards while drawing upon teacher collaboration to inform the science teaching and active learning components. As a research team, we actively sought out the skills, information, knowledge and energy required to teach science according the Standards. We quickly designed an action plan to implement that required the identification of barriers to teaching science in an elementary school setting. This action necessitated teachers working together to design lessons, gather materials needed, acquire help and assistance, as well as gaining knowledge about the topic. Throughout the study, we explore an elementary school science program and how these concepts are used.

In the next chapter, I describe the methods I used to study these ideas. I will also discuss the research team and setting and the study's process at length.

CHAPTER III

METHODOLOGY

Introduction

I used a qualitative participatory action research design in this investigation to study teacher collaboration in an elementary school and how teachers used it to help them teach science. This chapter discusses my design, the procedures used to identify the participants, the data collection process and instruments as well as the plan for data analysis.

Research Design

Case studies can be either single or multiple-case designs. Single cases are used to confirm or challenge a theory, or to represent a unique or extreme case (Yin, 1994). Single-case designs require careful investigation to avoid misrepresentation and to maximize the investigator's access to the evidence. Multiple-case studies follow replication logic. Each individual case study consists of a "whole" study, in which facts are gathered from various sources and conclusions drawn on those facts. My study is comprised of seven case studies. Each case study was a teacher who participated on the action research team.

Yin (1994) asserted that a case study investigator must be able to operate as a senior investigator during the course of data collection. There should be a period of preparation which begins with the examination of the definition of the problem and the development of the case study design. The preparation would

cover aspects that the investigator needs to know, such as: the reason for the study, the type of evidence being sought, and what variations might be expected. As the lead researcher and research team member, I collected the data as a multiple case study. Overall, the study was conducted by the entire team as an action research study.

Action research is a form of self-reflective inquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of these practices, and the situations in which the practices are carried out (Carr & Kemmis, 1986). Many people are drawn to this understanding of action research because it is firmly located in the realm of the practitioner - it is tied to self-reflection. As a methodology, it is very close to the notion of reflective practice conceived by Donald Schon (1983). Much of a researcher's time is spent on refining the methodological tools to suit the need of the situation and on collecting, analyzing, and presenting data on an ongoing, self-reflective cycle (Kemmis & McTaggart, 2000). The team met during planning sessions each week to reflect on the study. "The stages overlap and initial plans quickly become obsolete in the light of learning from experience" (Kemmis & McTaggart, p. 595). I collected data on a continual basis as the views and opinions were ever-changing and growing. This is an approach to research that is oriented to problem-solving in social and organizational settings and that has a form that parallels Dewey's conception of learning from experience. Therefore, I used the Experiential Learning Cycle (see figure 2 in

Chapter II) to ensure that the experience was generating ideas to enhance the next experience.

Kemmis and McTaggart (2000) discuss several attributes that separate action research from other types of research. Primary is its focus on turning the people involved into researchers, where people learn best, and more willingly apply what they have learned when they do it themselves. The research takes place in real-world situations and aims to solve real problems. I selected this methodology to allow the teachers to take an active role in the experience as we studied active learning strategies and science teaching methods.

Action research has a number of distinctive features, as described by Zuber-Skerritt (1982). It is the critical collaborative inquiry by reflective practitioners who are accountable in making the results of their inquiry public, self-evaluative in their practice, and engaged in participative problem-solving and continuing professional development. This methodology offers a systematic approach to introducing innovations in teaching and learning. It is critical that practitioners not only look for ways to improve their practice within the various constraints of the situation in which they are working but they also should be aware that they are critical change agents of those constraints, and of themselves. It is reflective in that participants analyze and develop concepts and theories about their experiences. Action research is participative in that those involved contribute actively to the inquiry, and collaborative in that the researcher is not an expert doing research from an external perspective, but a partner

working with and for those affected by the problem and the way in which it is tackled (Kemmis & McTaggart, 2000).

Case studies involve examination of a trend in its natural setting. The researcher has no control over the trend but can control the scope and time of the examination. Case studies are most appropriate when the researcher is interested in the relation between context and the phenomenon of interest. Action research into our own teaching practice is an important source of learning for a group. An action research approach to teaching can be used to improve teaching and learning practice. Case studies require the researcher to be distant. While action research allows the researcher to have the 'insider perspective,' the practice becomes "a collective way of reconnecting with questions of meaning, value, and significance, and of exercising personal and collective agency for the common good" (Kemmis & McTaggert, 2000, p. 594). Therefore, my study used a more encompassing participatory action research approach. This design allowed me to become not only a researcher but a partner in the teaching and learning. I selected this model to study in depth the perceptions of teachers for teaching science and what were the barriers to not teaching actively. Since teaching elementary school is very complex, I decided to consider each teacher as a case for the study.

Research Setting

My research study was conducted in a southeastern state in a large suburban school system that now has 116 schools, of which 67 are elementary.

The study was conducted at Middleton Elementary School, a School of Distinction three out of the past four years. In this state, student assessments include two major end-of-grade (EOG) tests administered each spring to students in grades 3-5. A School of Distinction means that the school's EOG proficiency is 80% or higher in both reading and math. In 2005, Middleton's reading school-wide proficiency was 82.3% and math was 85.7%.

Middleton Elementary's uniqueness is revealed in its size and rural environment. Its enrollment of two hundred seventy-five kindergarten through fifth grade students allows faculty, staff, students, and community members to develop personal relationships. The teaching staff has been relatively consistent with little turnover, only two to three new members a year. The entire teaching staff is highly qualified and 39% have advanced degrees. The school has an average class size around 21 and 95.2% of its classrooms are connected to the internet.

Collaborative planning with Middleton High School creates strong connections and a sense of ownership for the students in both buildings. The horticultural classes serve as mentors to students by teaching the care of our school grounds. The advanced agricultural science class teaches science lessons to various elementary classrooms. The leadership classes serve as classroom assistants and tutors for the primary grades. Active participation within the school environment helps bring the Middleton Elementary School community together.

The small size of Middleton Elementary coupled with the close knit community creates a sense of belonging for each student, parent, and employee. The school serves generations of families thus a true sense of community permeates. The Middleton community is built around a very active Parent Teacher Association (PTA). This group is abundant with volunteers and support. The school had over 2100 volunteer hours during the 2004-2005 school year. Its initiatives to increase parent and community involvement include membership dinners, community yard sales, community basketball games, festivals, talent shows, and student performances. Through service learning opportunities, students promote collections for the Ronald McDonald House, Urban Ministries, and even support our own community members who find themselves in need. In 2004-2005, Middleton's attendance rate was 95.8% with zero students being suspended out of school due to behavior.

Identification of Participants

I was the principal of the school that was the research site. As supervisor of the teachers, I was responsible for evaluating their performance. This created a potential for conflict. Since the study was purely voluntary, the inherent risk to participate was reduced. Precautions to avoid this conflict included: my insuring participants of the purpose of the study; my maintaining a non-threatening, safe environment for the participants during each interview; and my establishing a positive rapport with the participants to ensure a clear understanding of how data

would be used. Pseudonyms were used to protect the identity of teachers who were interviewed, the school studied, and the school district.

As the research leader and the principal of the research setting, I had a real stake in the outcome and potential growth of the teachers from this study. This opportunity to work very closely with a group of professionals who also wanted to create change within the school caused a new level of trust with me as their principal. I was able to participate in a more open and honest dialogue about teaching and learning. The participants were able to hear my concerns, questions, and issues with the current methods of teaching science. During the study, the team members began to feel confident and thus wanted me to observe their science class as a formal observation. However; I felt this would not be best for the research study for science lessons to become an evaluative piece in there annual evaluation of teacher performance. Therefore, prior to the study implementation, all teachers at the school site were informed that I would not formally evaluate any science lessons due to the nature of this study. I wanted the teachers to feel comfortable being honest about how they teach so the study could find valuable information and results. Throughout the study, I had to clearly define and adhere to my dual role as the lead researcher as well as school principal.

A participant decided voluntarily to recruit other staff members to join in this action research. This helped reduce the risk in participating in this study. I wanted to ensure other staff that the purpose of this project was purely research

and would not affect their personal evaluations. Therefore, the staff member who was recruiting participants also acquired their informed consent. This style of recruitment for the action research enticed the teachers at the school because the buy-in was apparent with this individual. Before anyone signed the consent form, she allowed them to ask questions and if she did not know the answer she would come to me to clarify. Once every question was clarified, the staff member asked teachers who wanted to participate to sign the consent. Out of a possible pool of 12 participants, seven signed the consent. Therefore, our research team consisted of six female teachers and one male with one research leader.

Table 1: Composition of the Research Team

Research Team
Hannah-Kindergarten Teacher
Kelly-Kindergarten Teacher
Jill-3rd grade Teacher
Braelyn-3rd grade Teacher
Jack-4th grade Teacher
Olivia-4th grade Teacher
Sarah-5th grade Teacher
Sara-Principal-Research Leader

The research team included of two kindergarten teachers, two third grade teachers, two fourth grade teachers, one fifth grade teacher, and one principal. In general, the team consisted of fairly new female teachers with the exception of one 26 year veteran and one male teacher. Three of the participants had either

studied science as a concentration in college or enjoyed teaching the subject in a team-teaching situation. Each participant was seeking avenues to grow professionally in the area of teaching science.

The ability of the team to get along and trust each other was characteristic of a small school setting. A few of the teachers were very close and were friendly outside of the professional environment. However, most of the team just knew the basic information about the team but did not work in direct ways to affect their teaching decisions. The weekly planning sessions were often over dinner which created a very relaxed and friendly atmosphere for honest conversations to occur. The data collected throughout the study documented these conversations.

Demographics of Research Team Members

Table 2: Demographics of Team

Participant	Gender	Ethnicity	Grade Level	Years of Teaching Experience	Years teaching at Middleton	Years teaching with co-teacher	Years with Principal
Jack	M	W	4th	7 yrs	1 yr	1 yr	1 yr
Olivia	F	W	4th	26 yrs	20 yrs	1 yr	4 yrs
Hannah	F	B	Kindergarten	2.5 yrs	2.5 yrs	2.5 yrs	2.5 yrs
Braelyn	F	W	3rd	4 yrs	3 yrs	2 yrs	2 yrs
Jill	F	W	3rd	3.5 yrs	3.5 yrs	2 yrs	3.5 yrs
Kelly	F	W	Kindergarten	4 yrs	4 yrs	2.5 yrs	4 yrs
Sarah	F	W	5th	4 yrs	4 yrs	1 yr	4 yrs

As seen in table 2, the teachers in this study range in years of teaching experience from twenty-six years (Olivia) to two and half years (Hannah). Four

teachers (Hannah, Jill, Kelly, and Sarah) began their teaching career at Middleton Elementary. Four of the teachers (Braelyn, Hannah, Jill, and Kelly) have worked with their grade level partner (co-teacher) for more than one year while the other three teachers (Jack, Olivia, Sarah) began working with their co-teacher during this school year.

Table 3: Participant History

Participant	Advanced Degree	National Boards	Leadership Positions at School	Team Teaching or Self-contained classroom	College In state or Out of state	# of schools taught
Jack	No	Awaiting confirmation	Science Contact	Self-contained	Out of State	2
Olivia	Master's	No	Leadership Team Chair	Self-contained	In state	3
Hannah	Master's in progress	Not Eligible	Behavior Team	Self-contained	In state	1
Braelyn	Master's	No	Curriculum Team	Self-contained	In state	2
Jill	No	Not Eligible	Responsible Discipline Team	Self-contained	In state	1
Kelly	Master's	Awaiting confirmation	Leadership Team	Self-contained	Out of State	1
Sarah	No	Awaiting confirmation	Responsible Discipline Team	Team	In state	1

The research team consisted of three participants with advanced degrees (Olivia, Braelyn, and Kelly) and one in progress (Hannah). During the 2005-2006 school year, three team members (Jack, Kelly, and Sarah) completed the

process to become a National Board Certified teacher. They will not know if they have passed the certification requirements until November of 2006. All members of the research team hold leadership roles within Middleton Elementary School. As teachers who have participated in an action research study, they will be the ones to lead Middleton to the next step in Science Education reform and lead others in the collaboration efforts.

Data Collection

In order to gain knowledge about each teacher who was participating and their current viewpoints, I conducted interviews with each. Interviews are one of the most important sources of the case study information. In an open-ended interview, key respondents are asked to comment about certain ideas. The focused interview is used in a situation where the respondent is interviewed for a short period of time, usually answering set questions. The interviews were designed to last approximately 60-90 minutes. The questions asked during the first interview were:

(1) Describe how you teach science. What is the most current topic studied and explain a few of the lessons used to teach those concepts?

(2) What do you have to do to get ready to teach lessons in science?

(3) Is this the ideal way you want to teach science?

(4) What makes you not able to teach the way you want to teach?

(5) What does the term active learning mean to you?

(6) Do you collaborate with colleagues to plan your teaching? How has it influenced your teaching?

Each interview was taped and then transcribed. As the interviewer, I asked each question and waited to hear the response from the participant. I would occasionally have to prompt the participant to allow him/her to expand on their thoughts. Each interview was very successful. Several interviews were over an hour long because the teachers wanted to discuss their lessons and views in depth.

The study continued with weekly observations of science lessons designed by each participant. During each observation, I collected artifacts such as copies of lesson plans, worksheets, textbook pages, and copies of student work. The observations were documented by recording the types of lessons taught and methods used. An observation form (appendix A) was used to complete the documentation. Research team members shared the time of day that daily science instruction would occur and thus visits were made during those times on a weekly basis for data collection. This type of observation was very focused and followed the collection form exactly leaving no question as to what was observed. This form made the observations for this study very different than the personnel observations required for evaluations since no scripting was required.

When the research team met for the first planning session, we discussed the data that had been collected thus far from the first round of observations and interviews. At that point in the study, we determined what actions needed to occur and designed a plan for overcoming the consistent issues that were described or observed. These issues included the lack of resources and materials to teach active lessons, the lack of scientific knowledge by the classroom teacher, and the need to have another person helping during the activity. By the sixth observation week, the action was fully implemented and these issues were no longer a problem. As a team we ordered several items that were necessary for the teaching of the units and developed a plan for helping each other teach the units. All research team members participated in another member's lesson as the helper. This action allowed the team to see first hand how the science lessons were being instructed.

More informal and less structured by the research leader, planning sessions occurred on a weekly basis for the remainder of the study. The team's discussions were focused on the units of study that the teachers were implementing in their classes and how the lessons were or were not successful. I held the final interview after the action research was completed to gain the participants' views of the action. The question I asked during this interview was much more open ended: How have your views changed about teaching science and teacher collaboration?

Data Analysis

This study generated a large amount of data in the form of qualitative textual information. I transcribed each interview and used the constant comparative method to find themes in the interviews. Stake (1995) refers to this process as a search for patterns both in the individual cases and instances within and across cases to find patterns. In order to make meaning from the enormous amount of data, I used color-coding to help organize my data analysis. I also used the cut and paste functions in Microsoft Word to create text documents that contained only the information from each participant related to a particular theme.

I kept a notebook with all my notes from the observations and planning meeting conversations. At this point, I shared the data that had been collected with the research team. The team members identified themes that were consistent concerns throughout the data. We determined that to become the types of science teachers that we all wanted to be we needed to overcome three barriers. The barriers were the lack of resources, knowledge and physical manpower to conduct the lessons. At this point, we made a list of the resources needed for the next units of study and I ordered each of the materials for the teachers. While we were designing the units of study, the research team collaborated on methods to use, ideas on where to gain knowledge, and offers to demonstrate lessons by team members. We also created a schedule for team members to be in each of the classrooms to assist with the activities. At the end of the research study, I interviewed each participant individually again to see if

their views changed. I incorporated the same method of color-coding to organize the data.

My next step after analyzing the cases separately was to compare the cases and look across all seven individual cases for patterns. Where I coded answers to questions and identified them with the individual teacher, I put all the related information together to look for similarities and differences in the responses. I used the *National Science Education Standards* as my basis for my conceptual framework for the analysis. I also evaluated the teacher collaboration component in the study using the Experiential Learning Cycle.

Trustworthiness and Validity

The data collected during my study can be trusted as reliable data that occurred during a five month period of time. Each participant shared their honest answers throughout the interview and then collectively shared during each planning session. I worked with each participant two to three times each week during the study to ensure their needs had been met, opportunities to ask questions, or even gain assistance throughout the study in regards to the action research project. As the school administrator for the school for four years, I worked with most participants that entire period. Thus, the feelings and comments they shared in the initial interview were valid since I had observed their behaviors in teaching science prior to the study. As the study was conducted, validity and trustworthiness were affirmed as the interactions, comments, and actions taken by participants were observed and documented.

Every piece of data throughout this study confirms and supports the views and actions of the participants thus the data is valid and trustworthy.

Reflection

As a participant in the action research, I feel encouraged by the results of this study. I was significantly anxious about being the principal of the school where the study took place. However, I knew that I wanted to mutually benefit from the study and grow with the research team. A personal goal as an educator was to instill a vision for teaching and learning to be centered on student engagement. I have always wanted students to experience the richness and excitement of knowing and understanding the natural world. As the research leader, I found myself encouraging the other team members to have this mutual vision. The most important task of all teachers is to inspire or motivate students to engage in learning. As a former science teacher and now an elementary school principal, this study has helped me inspire and motivate teachers to engage students through science. I also feel that this study has enhanced instruction in general to all subjects.

I observed each team member grow through this experience. Some grew more in learning how to talk professionally as educators focused on the methods of teaching. Others grew in techniques of teaching and learning. I believe that Olivia did not open up to the group with all that she has to offer. She has over 24 years of experience in teaching but she was the team member who seemed to always find the negative in each discussion or a concern with each idea. By the

end of the study, I think she was beginning to open up her box to look for what is outside of it.

Jack's growth in his opinion about teacher collaboration was amazing. He thought in the beginning that there was no collaboration at all at Middleton Elementary and at the end he was open to exploring more opportunities. Hannah and Kelly expressed their thoughts about the study by stating "how wonderful it is to know that we are not alone with our teaching anymore."

As David Kolb (1984) expressed "transformative growth comes through reflection on experiences where ideas and practices illuminate teachers' practice rather than usurp it." Jill, Braelyn, and Sarah became advocates for active learning throughout the school. They started encouraging non-participants to try some of the ideas that were being discussed in the planning sessions. All three reflected about the types of active learning methods they were going to continue implementing. As a participatory action research, this study was an experience for me to contribute to the teaching and learning as well as gain a personal relationship with each team member and become a partner in the teaching and learning of the students at Middleton Elementary School.

Summary

The methodology of this research study was an action research using seven individual cases. As an action research project, the research team worked together to identify barriers and create units of study to implement that were

considered the action piece of the study. This chapter contained the research design, setting, participants, and general results.

Chapter IV contains a description of each case in detail. Each case study contains an introduction to history of the case, a description of each participants' classroom, and their viewpoints from each interview. Chapter V describes the results when each case is compared for common views and analyzed using the *National Science Education Standards* for science teaching. It also provides the findings and recommendations for further research on this topic.

CHAPTER IV

CASE STUDIES

This chapter presents a summary of the data collected from each of the seven elementary school teachers who participated in the action research. The data are presented in detail in seven individual case studies. The studies span the time period between when the teachers began the project, the process of planning and preparing lessons, and the implementation of lessons developed collaboratively. The participants, whose teaching experience ranged from 3-25 years, were five Caucasian females, one African-American female, and one Caucasian male.

To protect their privacy, the participants have pseudonyms: Jack, Olivia, Hannah, Braelyn, Jill, Kelly, and Sarah. All of the participants were extremely helpful and willing to give of their time to provide needed information for this study. These case studies were compiled from data collected during two formal, structured interviews, open-ended informal conversations, lesson observations, and group planning sessions. Over a five month period, each team member participated in weekly planning sessions. I also visited each participant two to three times per week in order to provide support or conduct an observation for the study.

Jack

Introduction

Jack has taught elementary school for seven years. This year was his first year at Middleton Elementary School and his first year teaching fourth grade. Prior to teaching at Middleton Elementary School, Jack taught third grade at a local charter school. He described his prior school as a school that as a whole did not work well together due to the lack of quality leadership but his grade level developed a partnership to build on the strengths of the team. During the year at Middleton Elementary School, Jack earned the Parent Teacher Association Teacher of the Year Award. He serves as the school science contact person for the school district. This means he attends meetings and shares information to the staff about science. He also conducted a workshop for teachers about inquiry based teaching.

Jack's classroom is arranged to maximize the space to benefit the students and to aid in classroom management. His room reflects his interests. It is filled with books, student work, and colorful mementos that attest to his love of learning. His children sit in desks facing each other in islands of six. Jack uses a commanding presence with the children of mutual respect. He does not raise his voice to gain attention and focus for each lesson; instead he has a repeat command. A community of respect is consistently apparent in Jack's classroom.

First Interview Viewpoints

Planning

Jack believes that his planning of science units is impacted by the time factor and his access to materials. For his unit with animals and habitats, he stated,

> I knew I had the time for all the activities and all the materials I would need. For our upcoming units of study we are talking about electricity or properties of soil or types of rocks. My planning is impacted because I am not really aware of all the materials available here in this building, if any. So, it's going to greatly impact, I mean if I'm going to want the students to construct a series of parallel circuits. I'm going to want to have those materials available. I don't particularly know if we have those. So it effects my planning. I am going to have to go out and seek those out. I have been doing this for a few years so I have some materials.

His newness to the school and his disappointment in the lack of collaborative planning is reflected in his comments.

> Well, I am new to this school. I was coming from a setting that made it a point to plan weekly and plan daily as we were going to really hit science instruction. This place where I was coming from, there was a large emphasis on inquiry based science, student exploration, and application. Here there is not as much emphasis on it … It would be in an ideal situation we would all have a common knowledge of what we were going to teach that year and how we were going to assess it. Follow the standard course of study, use materials on site that were going to help us to meet those objectives. Just plan together and see how things are going.

Collaboration

In his first year of teaching at the Middleton Elementary School, Jack admits that he usually does not plan with his colleagues and stated that this school's setting "has not been as productive or as conducive as I am used to in the past." He thinks that an ideal teaching setting

> …would be having more input from other colleagues and planning together… That has been beneficial to me in the past. It has impacted me this year as I do not have those other resources … Planning with other colleagues is another limiting factor. It is just not occurring as frequently as I would like it to occur.

Active Learning

Jack says that active learning, to him, means that,

> Students are involved actively. It means I am involved in the learning process. I'm helping them to construct meaning at the same time they are constructing meaning … Everyone always says hands-on learning but that is not always applicable. There are certain things that you can't have hands-on learning going on all the time. You have developed their understanding conceptually.

Teaching Science Lessons

Jack tries to include an activity where the students build on their understanding and uses the textbook as one of many resources. Jack feels that the newly adopted textbook is "a good resource but it is not the only one."

Second Interview Viewpoints

Collaboration

Collaboration "has been a vital part" of Jack's teaching. He thinks that if he can hear about a colleague's ideas, that he is more likely to attempt an activity or strategy that a colleague is using. Having a shared philosophy lends to collaborative work among teachers, and he observes "students growing and understanding where they're headed and having the understanding that their teachers are united on what they want to have them learn makes a big difference."

Jack feels “a sense of camaraderie, a sense of collegial professionalism.” Collaboration “is not just only about resources. It’s about having someone along side of you who supports you saying ‘that’s pretty good and you could try this’. It is willing to explore other opportunities.” Jack shares,

> I feel confident in sharing my ideas, too. Recently I was sharing my ideas with a 5th grade teacher, and she asked if I had some research on or materials on motion. I said, “Yeah I have some great Power Points. Here try this out. Look at this book, it’s a good resource.’” I felt comfortable sharing those because that is how I obtained them … If I can share my resources with anybody to improve their science instruction; I’m willing to do that.

Evolution of Teaching throughout Study

Prior to the study, Jack used a variety of teaching strategies that allowed students to participate in active learning lessons. Jack shared during his first interview a lesson about adaptations of organisms and natural selection. He used a variety of teaching strategies that he believes assist in constructing knowledge. In his exploratory lesson, students learned about the colors that are most helpful to animals so that they survive longer. To illustrate the concept, he described

> toothpicks [were] displayed on the floor that were colored and the kids were investigating camouflage. Then they had five minutes to go ahead and find as many as they could. It was a bird simulation. They had to be about 20 feet away. The idea was that you would pick up the bright colors first because they don’t blend in as well. Then after collecting our data we went ahead and constructed graphs based on the most prominent colors that they selected. But while they were collecting I asked them to think about the strategy they were using to go into the display such as picking the ones closest to you, picking the brightest. I had them write them down. I wanted them to really get into inquiry. Why

they doing what they were doing? So after that we constructed graphs and we analyzed what happened.

To construct knowledge, Jack also explained a lesson where students studied the microevolution of a pepper moth. He used a teacher developed PowerPoint presentation to explain that some insects are better camouflaged than other animals. Jack described the industrial revolution and its impact on the white pepper moths' population as pollution infiltrated the air. Jack states, "I wanted the kids to understand that pollution was not killing the insects, but that the trees were changing colors. And that the white [pepper moths] were not blending in as well as the black ones, and the idea of natural selection came up. The white ones were getting eaten by the birds because they were being seen better. The dark ones were surviving. So that changed the population." Discussions afforded the opportunities to process this concept.

Now that Jack's unit allowed students to explore the concept and build knowledge, his next lesson allowed students to apply what they have learned by observing their own classroom environment. He used questioning to probe the students, "What do you see around you? What textures and things do you see?" After making these observations, students developed a plan and constructed insects that were placed throughout the classroom where the students felt they would blend the most. Students were challenged because they had to design their insect, use technological designs, and determine places to hide their insects. Jack says, "I wanted them to think, 'How can I make mine blend in better?' They are really applying these concepts. 'What's

going to make this harder for someone else to see?' 'Oh, maybe I could use cloth on this?' or 'Maybe I could change the color so I use black and orange so it blends right into the cabinets on the drawer.' It was real successful. Once again they were getting into the inquiry."

Throughout the study, Jack incorporated more activities and lessons such as projects and cooperative learning lessons. His teaching evolved into stronger processing of the information and building on the process of the student understanding. He contributed a lot of lesson ideas to each unit of study that was developed in the planning sessions with the other research team members.

Summary

Basically, Jack believed that collaboration did not exist at Middleton Elementary especially at his grade level. After the planning sessions and collaboration began through the research, Jack's views on teacher collaboration changed. Jack has a very rich background in science and therefore he contributed a lot to the planning sessions. He also shared and demonstrated for the research team examples of the lessons he was using with his students. By designing lessons which incorporated inquiry, knowledge, and application, Jack's lessons built-in active learning thus increasing the student's experiences and understanding. The team benefited from Jack's expertise and he benefited in the collaboration with others even though he still felt that at his grade level the collaboration could still improve.

Olivia

Introduction

Olivia has been teaching for 26 years. She has a Master's in Elementary Education from an in-state university that is located within the county that she teaches. She has taught at two other schools, however, she has been at Middleton for 17 years. Olivia is very active within the school as she serves on the school leadership team as the chairperson. She has held this current position as the chairperson for 15 years. As the teacher representative for the Parent Teacher Association (PTA) board, Olivia contributes the teacher viewpoint and shares the needs of the association with the teachers. She has been selected as the school Teacher of the Year to compete at the county level three times and as the PTA Teacher of the Year four times.

Olivia is a traditional teacher with rows of desks, an overhead and board being the central focus of the classroom. Her lesson plans are textbook driven where you find page numbers to complete throughout each subject. She is very organized and has a place for everything in her room. The students clearly understand what is theirs to use and what is just for the teacher. When observing her teaching, her students were completely quiet with her explaining the lesson at the board or the overhead. The students then completed a page from the textbook or a worksheet. This was the same observation throughout the project.

First Interview Viewpoints

Planning

Olivia reveals, “I have taught for a long time. I don’t know that I do a lot [regarding planning] … I don’t feel like I spend maybe sometimes as much time as I should spend preparing.” Olivia explains that less time is spent preparing for and teaching science because many teachers dedicate much more time preparing for reading and math. In the ideal setting, Olivia expresses that “if I’m preparing for science, of course trying to get the materials ready. And locating the materials within the school and what I already have on hand … Now a days trying to find a hands on things that you can find on the internet because there is not enough in the book. You know, there are not enough experiments.”

Collaboration

Olivia shares that she has collaborated in the past, but this year has not been successful in doing so. When Olivia would collaborate with colleagues, she remembers that teaching was much better under those circumstances. “I do think you get more energetic lessons out of it when you collaborate with somebody else and you can join in. I can remember years when I taught with somebody that we thought alike and we were able to brainstorm and put together great lessons because we fed off each other.”

When Olivia thought back to when she collaborated with colleagues she shared,

> I think [collaboration] makes me a stronger teacher. It gives me ideas from other people. I don't rely just on myself I am certainly not a genius at coming up with all the ideas to keep my children motivated. I think it takes more than one person you know that old saying it does take more than one of us to keep everything going. So sometimes you feel like you are out on an island by yourself, you drown quickly.

She feels that teachers are stronger because they become more knowledgeable in specific curricular areas because of the sharing of ideas with others. However, through collaboration, she admits that "the more you work with other people or the more you do it of course you feel more confident." Through collaboration within a grade level, lessons and units are created and add to teacher's understandings of specific concepts.

Active Learning

Olivia describes active learning as "handling and manipulating things and it can be active participation in discussion."

Teaching Science Lessons

Olivia confided that she does not feel comfortable teaching science because she believes she does not have the knowledge base to teach the students. She discloses her feelings of inadequacies:

> Today we talked tornados. I don't have a real understanding of tornados and how they work. I have a simple understanding of how they are created so therefore when we begin to discuss it the kids ask lots of questions. I mean I don't mind telling my kids "no, I don't know." And yes you can certainly go find that out or we can look together but I don't have that prior knowledge. Even after having taught it forever, I am still not an expert in it.

During the current school year, Olivia has taught animals- habitats and the difference between vertebrates and invertebrates. She describes her

lessons as “looking at it in reference to the text, looking at some pictures of animals because it is hard to bring animals into the classroom.” Students have created Power Point presentations of different animals and included information about their habitats, how many young they had, their mobility rates, their food selections, and a picture. Olivia continues with:

> …so we really for this unit have just looked at the text and read from the text and kind of go back and understand. I just haven’t spent a lot of time with that. We hope to move on, if we get through with animals, to another topic. Then more hands on. I think animals just don’t lend itself so much to do much hands-on.

Another science unit is electricity, and Olivia describes her lessons as doing

> some modeling and the kids can share in that. Participate some. I don’t usually do group experiments. I mean I would love to but a lot of it just doesn’t lend itself to having the materials. When we have the materials, we can. A lot of times it is sharing and ‘look at this’ and one or two coming up and sharing with that.

Second Interview Viewpoints

Planning

Olivia reveals that her experience with the research team was nice to have someone to brainstorm with for planning a unit. “Some of the ideas were quite far fetched and impossible to teach but I listened anyway.”

Collaboration

During the interview, Olivia was apparently not happy with her grade level partner. She stated several times that they did not see teaching the same way and that they did not have enough experience in teaching yet to know that the activities would not work with ‘our’ kids. “The units that were

planned during this research project were not my comfort level of teaching. I think my kids got more out of the science lesson when someone else came in to share an activity." Oliva also commented that she learned from the others in the team and benefited by participating. She states that through this collaboration, "I have a better understanding of what I am teaching and the children have a better understanding of what they are learning."

Evolution of Teaching throughout Study

At the beginning of the study, Olivia was observed as teaching very passively. Students were always sitting at their individual desks not moving around the room. There was a textbook on their desks. The assignment on the board each time stated pages to read and questions to answer. The students were not observed to be actively engaged in the science content. Once the planning sessions began, Olivia began incorporating a few active learning strategies into her science lessons. For example, students were manipulating objects or working together in small groups. She did not evolve as quickly as the other team members in shifting her teaching style but she did make attempts to practice the methods that were discussed during our sessions.

Summary

Olivia was the most veteran member of our research team. She was not as strong a contributor to discussions and planning sessions as many other team members. Her teaching style in general is very traditional and textbook

driven. Her viewpoints in each interview supported the resistance she often faces in times of change. She commented during one planning session by stating "this too shall pass." She was referring to teaching using the science kits.

Hannah

Introduction

As a relatively new teacher, Hannah has taught Kindergarten at Middleton for two and a half years. She was hired in the middle of the 2004 school year when a teacher moved out of state. Hannah graduated from a local university in December 2004 and was highly recommended by her professors for the position. Her degree in Early Childhood Education prepared her for teaching ages birth through kindergarten. Hannah serves on the schools Behavior Support Team and was selected to attend Teacher Academy for new teachers who are potential instructional leaders. She has also begun her Master's degree work in counseling.

Hannah's classroom has five rectangular tables with student name cards designating where students should sit. There are four students to each table with a basket of books and a basket of materials in the center. The materials include pencils, glue sticks, scissors, and crayons. Surrounding the student tables, there are various work stations and centers. There is a writing center, reading station, computers, manipulatives, listening center with a CD

player and headphones, Technology center with Leap Frog materials, and a teacher station set up for small group reading.

Hannah teaches using themes. The theme for the week incorporates each subject. During one observation, the class theme was Animals. She used the book "Brown Bear, Brown Bear" as a central part of the unit. The students learned about colors, counting animals, and in science studied the differences between living and non-living things. Hannah's teaching style is very energetic and requires lots of student movement.

First Interview Viewpoints

Planning

Hannah explains her preparation for science lessons to be about a week in advance so that she has the materials for each day of the week for the lessons. She uses resource books, the internet, and the text book.

Active Learning

Hannah shares that active learning includes "students having hands-on, … but being able to get up and do things. Not just sitting at their seats, or busy worksheets. I don't think it is active learning."

Teaching Science Lessons

In Hannah's unit about frogs, she used a KWL (Know, Want to Know, Learn) chart to start the lesson, which guided the rest of the unit so the students' questions were answered.

> [t]hey told me what they already knew about frogs, which was very interesting. And what they wanted to learn. They really wanted to know

> some really good things like how they catch their food? How high they can jump? Where do frogs live? Do they sleep during the winter? Do they hibernate? They wanted to know all those things. … [W]e just read facts about them. We did some hands-on things as far as the life cycle. They also got a chance to be frogs and what frogs eat. The frogs were the little poppers (birthday treats). They were able to catch the flies which the students were blowing bubbles and they had to predict how many flies they could possibly eat that day. They were able to see if they had the right prediction. It worked out really good. They really seemed to enjoy it.

In addition to the frog unit, Hannah also taught a unit about the seasons where students described what happens during each season, how many seasons there are in a year, when the seasons change, and what months are associated with what seasons. Students drew pictures of activities they would participate in during the different seasons. Hannah also used the current season to talk about the weather outside. The class went on a nature walk where they observed the various changes, brought back leaves to the classroom and noted the differences in the leaves between seasons.

Second Interview Viewpoints

Collaboration

Hannah explains that collaboration has positively influenced her teaching because people are "able to work together and come up with several things you can do with any lesson … It just makes it easier I think." She continues, "It goes back to having that person to talk to about things that are not going well and how you can change it to make it better for your class and your students." Students ultimately reap the benefits of collaboration because

their teachers' lessons are better prepared and implemented due to the input of other teachers.

Active Learning

When Hannah commented on Active Learning, she immediately began describing how her opinion of that phrase has changed. She explained that she did not realize that active learning has many forms other than hands-on and that "it truly involves the child's mind being actively engaged in what they are learning."

Evolution of Teaching throughout Study

Prior to the study, Hannah was teaching science through theme teaching or integrating the concept into her reading lesson. Most of her lessons had a passive tone in which students where listening to Hannah read a story or explain a concept and then they would watch her demonstrate the concept through modeling or completing a worksheet activity.

During the study, Hannah incorporated active learning strategies on a regular basis. The students were engaged in manipulating objects that explain the concept or worked in small groups to explore an object and ask questions. She implemented the unit of study on butterflies and began working towards creating more units for the next school year that were following the same teaching methods.

Summary

Hannah's style of teaching science is very intertwined throughout the day's lessons; so much so that the students do not even realize what subjects they are learning during the day. With the constant movement and student engagement, she was unaware of how much active learning she was actually providing her students even before the research began. She stated that she truly enjoyed this opportunity to be a part of the research team not just to benefit her students but to give her the confidence to continue in this profession. The climate of the team was something that "I look forward to and I hope it continues."

Braelyn

Introduction

As a 4th year teacher, Braelyn feels knowledgeable about science due to her collegiate background. She began her undergraduate program wanting to be a physical therapist so her coursework focused on intensive science classes. Braelyn continued her studies to obtain a Master's degree in Elementary Education. Her first year of teaching was in second grade at a school near by but in a different county. She moved to Middleton Elementary to teach third grade. She was elected to the school leadership team to represent the second and third grade staff members. As a teacher leader on the Curriculum team, Braelyn attends the Pathways to Achievement trainings and then shares the best practices with staff.

Upon entering Braelyn's classroom, one feels as though they have ventured under the sea. She has nets and fish on all the walls. Her word wall has seaweed growing on the bottom. With a fish tank and other sea creatures around the room, students are immersed into her classroom. Her desks are arranged into pods of four with a large open space in the back of the room for floor activities.

Braelyn's teaching style is a facilitator style where she gives students the information to explore and work with each other to discover the answers. Rarely is Braelyn lecturing the classroom on a topic. During the observations, Braelyn was seen tossing a plastic fish about the room to check for student understanding of a topic. If the student caught the fish, they were to answer the question. The students seemed to really enjoy this technique and looked forward to the fish coming their way.

First Interview Viewpoints

Planning

She shares, "a lot of times it is outside of the classroom and outside of the school building which is fine, but it is time consuming." Braelyn and her co-teacher plan together, and she described that in the

> beginning of the school year, we do it … once a week. We had one day that we would just sit down and it was our busy day. We would just plan however long for the next week. But now, we have gotten more in the habit of doing, because we have a couple of set things that we do every week. Mondays we might plan for our spelling unit. On Tuesdays we might plan for our Math unit the next week, so we definitely plan everything together.

Even though Braelyn and her co-teacher have a set planning schedule, she prefers more planning during teacher workdays and the summer not just the after school time because teachers are worn down by the end of the day. Planning is imperative to successful lessons.

Collaboration

Braelyn explains "most definitely" when asked if she collaborates with her co-teacher. Collaboration is beneficial because they have different strengths and they learn from one another.

> In our instance, my strength is Science, so I bring more ideas and things to the plate, where as Reading is her strength. But it really helps us to have resources or to know background experiences where you feel comfortable teaching that subject. She really relies on me for that particular subject.

Braelyn adds…

> I hear about all of these workshops where these teachers plan these great units over the summer time. I feel that if that could be a type of professional development, you can spend time together in the professional setting, but there should be some level of personal relationship there.

Braelyn acknowledges that collaboration…

> helps me so much because I realize, and [I am] totally aware that my strength is not everything. I am not good at teaching everything, Math, Reading, writing and everything. So if I have someone there who can help me with --here is a really good writing idea. Then we are both better teachers. We have considered maybe team teaching and her teaching what her strengths is Reading and Writing and with me doing the Math and Science. That might be something we try. It is just that if that person is a better teacher at that subject then the kids learn better because the teacher is excited about it and enjoys being there and talking about it.

Braelyn feels that students reap the benefits when teachers collaborate.

Active Learning

Braelyn describes active learning as “Kids are not reading in the book. They are engaged and they are doing something, producing something. They are not just sitting there, they are moving their bodies, they are talking or they are having discussion with the kids. And not just bored to death.” Because of her thoughts of active learning, Braelyn prefers her science lessons to be hands-on and “totally throw out the book, because I see the kids … [and] I watch how much they are in awe. And they are amazed at doing hands on things and will do what ever you ask.”

Teaching Science Lessons

Braelyn described a unit she taught on the solar system, focusing on the moon, sun, and earth. Students completed a moon observation project at home. Every night, students observed the moon and witnessed the various phases of moon over the course of a month. To illustrate the rotations of the sun, moon, and sun, “the kids had to physically get up and demonstrate how those rotations” occurred. Still teaching the concept of rotations, students used the overhead projector and a “styrofoam ball to rotate themselves, as the earth, to see how the [overhead] light, or the sun, would make the moon look from their perceptive.”

Braelyn recalls a lesson from last year in their soil unit.

> Before even introducing the unit or reading about any of the unit, I know we have done discovery learning things where the kids are actually doing things before they even know what to call these things or what the properties are, kind of learn as you do it. To me, that is really

> interesting because the kids have the experience to go on as they read after the fact after they have done it before. This is pretty cool and the kids hold on to that and owned that a little better than reading about it and then doing it after they have read about it.

Second Interview Viewpoints

Collaboration

Braelyn's view on collaboration changed from the first interview in that she "did not realize that how much others on the team could contribute to her teaching and how much she could help benefit others." She enjoyed gaining the personal relationship that has been created with the team. Even when Braelyn left on maternity leave at the very end of the study, she emailed ideas and thoughts to the team members as she was "missing" the time together in the planning sessions. "I feel like next year will be a stronger year in my teaching. I will be able to go to more people for ideas."

Evolution of Teaching throughout Study

Braelyn uses various teaching methods in teaching science lessons. Using small group activities and situational examples, she would teach science concepts in a way that would engage students but also have components that relied heavily on the textbook and the activities in the teacher's edition. During a unit of the human body and the skeletal system, Braelyn's students participated in different experiments that were found in the science book. The activity explored joints where students used tape to experience why the joints are necessary and how it would feel without the use of those joints.

> … we did the gliding, the ball and socket, and [I instructed the students to] 'Put your arm beside your body and you [can] not move it … now tie your shoe … then tape your two fingers together… now tie your shoe.' We just did different little experiments and hands-on things.

Additionally, Braelyn utilized a laser disc and students viewed pictures of different bones since she does not have any skeletal models. For review throughout the day while teaching various lessons, Braelyn shares that she would say, "… [T]ouch your humerus. Touch your clavicle. Touching a bone to constantly bring it back in their minds and talking about it."

Throughout the study, Braelyn shared her knowledge of science and her experiences as a physical therapy major in college to help contribute to the planning sessions. She admitted that she is much more confident in teaching biology concepts than any others. She seemed very open to new ideas and trying the strategies that were shared during the sessions.

Summary

Braelyn was already teaching science in a very active way but was feeling somewhat on her own since her partner was not as knowledgeable about science. Having the background knowledge was her strength in teaching. Braelyn creates a classroom that is conducive to active learning. She enjoyed the collaboration due to having more ideas and people to talk to.

Jill

Introduction

Jill began her teaching career at Middleton Elementary School as an interim teacher in first grade in 2003. She earned her Bachelor's degree in

Elementary Education at a university within the county and graduated in December 2002. She was hired in the middle of the school year after a teacher was promoted to another position in the school. Jill was given a permanent position the following school year as a first grade teacher. After a year and a half of first grade, Jill wanted to work with older children. She was given a third grade position and she loves teaching third grade students. Jill has been a leader in the Responsible Discipline Process at Middleton Elementary which is a teacher group responsible for designing and implementing school wide behavior guidelines.

Jill set up her classroom as a jungle. She constructed trees in the corners of the classroom. Each bulletin board has an animal print fabric such as tiger, leopard, and zebra. Her cursive letters across the top of the board have different animals for each letter of the alphabet. Her desks are arranged in a large u-shape where students are in a row. When teaching, Jill often uses a traditional method combined with grouping strategies. She teaches a mini-lesson about a topic and then has the students complete a task as partners or small groups.

First Interview Viewpoints

Planning

Jill, a third year teacher, discusses planning with her co-teacher, "We start, and I say 'we' all the time because the other teacher and I plan together … which is very helpful. Because I think I would be lost a lot without someone

else's help." She and her co-teacher begin planning by utilizing the curriculum maps they completed during the previous summer. This map includes the objectives they are to address each quarter. Jill explains that their lessons usually begin with them finding an activity that they think will be fun for their students. From that activity, the information or content of the lesson follows. Jill explains "a lot of times we come up with the activity part of it first because it does feel like science needs to be hands on."

Jill confesses that planning science is difficult for her because she feels that she does not know a lot the content area. She believes that science needs to be "fun and interactive," yet she is unsure how to blend the activity with the information.

Collaboration

Jill states that collaboration makes planning and teaching easier because there is

> …someone to bounce ideas off of, it lessens the load … [because] you are not the one always coming up with everything that you are doing. Not only that but it makes it more fun. You know, having someone to talk to, to share what you are doing.

Jill believes that collaboration is "an advantage to the children because the fact that we are teaching the same things, we know that all of those kids are getting the same thing so that when they go on to the next grade level they are going to be pretty much at the same place." She also feels that their collaboration is an advantage for the teachers in the next grade level because

the teacher will know that all of the students in that grade have the same knowledge. Jill simply feels that collaboration is an advantage for everyone.

Active Learning

Jill thinks the term active learning means that…

> the students are engaged in what they are doing, I think it means sometimes hands on learning, but it means that they are interested in what they are doing. It means they are asking questions and they are answering questions. It means that they want to know more, I think. I think active learning can mean that students are looking for information on their own also. They are choosing to continue looking for more information or finding things out for themselves.

She also feels that the teacher's role in active learning is to move students toward goals. This process is not accomplished by just providing them the information, rather by students discovering the information to reach the goal.

Teaching Science Lessons

Jill explains that most recently students studied the sun and moon and its rotations and orbits. As an introduction to the unit, Jill began with an anticipation guide and then one day used the textbook to read the content and learn some of the vocabulary words. The class discussed "attributes of the sun … What is the sun? It is a star. … How does it help the earth?" To teach the rotation concept, Jill describes

> We talked about the earth's rotation around the sun and how the sun stays stationary, and we rotate around the sun. We used children actually that day. We had one stand with a sun poster, and my other kids rotating around the sun. They got all dizzy, but that was a lot of fun.

To continue the learning of the moon and rotations, students completed a moon project "where the kids had to watch the moon for a month and record the different phases of the moon." In class they would discuss the phases of the moon and how the light from the sun is what gives the moon light." When students completed their month long observations, the class took a tally of what was seen during the month. Because not all of the students saw and/or recorded the same things, the class discussed why it looked differently to some people and not all people see the same things.

Jill also taught about bones and the skeletal system. Jill placed students into groups; within their groups, students had several pages of a skeleton. They cut out the pieces and put them together. All of the bones were labeled with the scientific and common names. Next, she used a laser disc about bones; she describes that this resource

> totally enthralled the kids even though it just showed a picture at a time. But they loved it. That comes with a script thing that you just read as you go through it. That was really good because it compared bones, like animal bones to human bones.

Because the students were so interested in this resource, Jill used it for two days. After Jill read the script that accompanied the laser disc to the students, students engaged in discussions that stemmed from student questions.

> We saw a bone from a dog or something and it was kind of a hip bone, and they would look at that and then I would … [say] "Feel your hip bones, do you think your's is shaped the same? Or, we do not walk like dogs so, so does ours need to be the same kind of bone?" A lot of it allowed them to be with a partner. The picture would show your spine,

> "Reach to your neighbor's back, and see if you can feel the spine." They asked a lot of questions about how your bones feel because they could see. It showed the inside of the bone and they could see the marrow. But our bones are hard, you know. They did not understand that on the inside of the bones it is not always hard … [T]hey all had stories of course, breaking bones, or their cousin broke … Those stories lead to how they [the bones] fix themselves and how bones … are alive. That was a big issue, bones are alive, there are blood cells in there, and they produce different things. So, it led to a lot of different discussions.

Second Interview Viewpoints

Collaboration

> Reflecting on the impact of collaboration on her teaching, Jill shares:
>
> I think it has made me more aware of teaching styles for one. It has opened up my creativity because I have been challenged to do things a different way than what I am used to--thinking outside of my box. It also has caused me to be more organized, because I am not working for just myself. You know, I am working for someone else also … I think it has been beneficial to the kids. Again, they are receiving more than just me. They are receiving more ideas, they are receiving more of me because they are getting things that I may not have thought of on my own, but things that when put together with someone else I have come up with.

Active Learning

Jill has incorporated more cooperative group work in her classroom because she has learned techniques that empower students since they are given a purpose or job in the group. This grouping allows Jill to monitor and assess students' learning because they are fully engaged in their activities. She shares that the lessons progress much smoother compared to her previous style of conducting group work.

Evolution of Teaching throughout Study

Jill, admittedly, relied heavily on Braelyn to assist her in the planning of science lessons for their grade level prior to this study. She used the textbook to guide her lessons and use activities that Braelyn shared to enhance the textbook. The students were not actively engaged in the science lessons except for once a week when she would conduct an activity.

During the study, Jill began to open up to the group with her resistance to science teaching since she lacked the knowledge. She implemented the unit of study and began to incorporate some of the teaching methods in her other subjects to teach.

Summary

Jill entered this research a little timidly. She admitted that science was not her favorite subject and that "I rely on my partner for all my ideas." During the early planning sessions, she was very quiet and seemed to take a lot of notes throughout each conversation. During the weekly observations, I saw Jill attempting to try some of the lesson ideas that were described during the planning sessions. She grew a lot in her ability to take risks as well. In later planning sessions, she began asking questions and giving examples of things she had tried. She also wanted to know how to improve or make a lesson stronger.

Kelly

Introduction

Kelly moved from New Jersey four years ago to begin her teaching career. She was first assigned to another school in the district but after the first ten days of school in 2003, she was moved to Middleton. She was given a fifth grade position even though she wanted to be a lower grades teacher. After one year at Middleton, she was offered a permanent position as a kindergarten teacher. Kelly has taught kindergarten for three years. She earned her Bachelor's degree in Elementary Education and immediately continued her studies in New York for a Master's degree in reading. As a representative for the kindergarten and first grade staff, Kelly serves on the school leadership team. This year, 2005, she completed her National Board Certification process and is awaiting the acknowledgement of the certification.

Kelly's classroom is very student oriented as her students are 5 and 6 years old. Most things are placed at a height that allows students to access the materials and items. She has four rectangular tables with student name cards. In the back of the room she has a brightly colored carpet that is surrounded by bookcases full of books and manipulatives. This area is set up for group time and floor activities. She also has areas around the room designated for centers. The center topics include: reading, science, math, writing, and blocks. Kelly's teaching method of choice is small group

assignments and centers throughout the entire day. She works with a small group of students and facilitates the groups.

First Interview Viewpoints

Planning

Planning science lessons requires “a lot of hard work” according to Kelly. This 4th year teacher explains that she spends more time brainstorming ideas for science compared to lessons she develops for literacy and math. She finds herself referring to teacher resources and even utilizing the internet for additional ideas. Kelly reveals that planning science lessons takes “me a lot of time to put the lesson together as far as creating the graph, creating the clues for the pictures,” items she uses in lessons. Although Kelly usually plans in isolation, “my co-teacher and I will usually bounce ideas off of each other.”

Collaboration

Kelly collaborates with her co-teacher because “she is a great teacher and great resource ... Sometimes when I am thinking about a lesson like staying healthy, and I think of a couple of good activities, I go to her. Then she might have a couple of her own good ideas. Then it is awesome because we have a whole week’s lesson plans. We are a good complement to each other.” Kelly and her co-teacher value their students' opinions and know what types of activities they like so they develop lessons that are well received. Even though they do not plan every lesson together, they communicate frequently and for

the most part they follow the same schedule and lessons for each week based on the curriculum map they developed the summer before school started. This consistency ensures that their students are learning the same concepts.

Active Learning

Kelly describes active learning as

> center time. I think of walking in, seeing kids in small groups. I think of them doing something. I think of them working with each other, working with the other students in the room, maybe working with the teacher. I think that active learning is basically learning by doing. Having them up and not just sitting in their seats and copying something off of the board.

Teaching Science Lessons

Kelly describes her weather unit beginning with her lessons about spring. Students viewed various pictures in a calendar and discussed what happened during the months of March, April, and May. Following the discussions, the class read a spring poem which reinforced specific words associated with that season. To relate the poem to the pictures, the students looked at science cards which accompany the state adopted materials.

During the lesson about fruits and vegetables, Kelly and her students read different books each day to illustrate the characteristics of fruits to compare and contrast them to vegetables. After listening to a book on tape that discussed different foods that grow from seeds, students categorized the foods as fruits or vegetables. By relating healthy eating habits with the fruit and vegetables, Kelly addressed a Healthful Living Objective along with a Science objective. Kelly describes a culminating activity for this unit,

> I created a graph on the board with fruits, vegetables, and 'other', and taught them what the word other meant. Around the graph we had pictures of different choices of healthy foods. I gave them a clue to find the food, and they needed to put them in the correct category. So that was really neat, because it gave me the opportunity to assess their understanding. And it was fun for them because it was hands-on and we played it like game.

Second Interview Viewpoints

Collaboration

Collaboration has taught Kelly that teachers can teach the same concept in a variety of ways. By collaborating with her co-teacher and the team, she has learned "different ways of doing things … [which] may enhance" the teaching strategies that she already implements in the classroom. She is open for suggestions and explains that another teacher "might have a really good idea and my idea might be OK, but it might need a little bit of work. So I think collaboration has helped me because I have been able to think outside the box and think of something that I would not have otherwise thought of or would not have occurred to me." By working with colleagues she stated that she is able to "incorporate other ideas" into her lessons. Collaboration is mutually beneficial, because she has influenced others' teaching as well. Kelly exclaims, "So that is really cool because I have gotten to learn different ideas from just walking into the next classroom or down the hall."

Evolution of Teaching throughout Study

Kelly incorporated her science topics into her centers and readings for the theme of the week. Most of the science activities were manipulating the

content by coloring or cutting and pasting from a worksheet. Throughout the study, Kelly incorporated the active learning strategies into her lessons and began to share ideas with the team of how they could use them. Kelly used manipulatives, centers, partner activities, and experiments after the project began.

Summary

Kelly is a teacher leader at Middleton that the teachers seem to confide in and trust. However, she has not worked in a collaborative way for improving her teaching until this research study. She heard about this study during a conversation at a Leadership Team meeting and was the person who recruited others to join the study. She stated that she really wanted to see how a "professionally focused group of teachers could improve teaching." She wanted to learn more about teaching science due to her lack of knowledge of the subject matter. She changed throughout the study by absorbing the active learning components and the focus on instructional techniques. She also enjoyed the reflective times during the planning sessions because she always came to each session with questions about why the specific activity she tried had or had not worked with the students.

Sarah

Introduction

Sarah has been teaching for four years. She began her career at Middleton Elementary in 2003 immediately after graduating from a local

university. She also grew up in the same county school system where Middleton is located. During her four years at Middleton, Sarah has taught second grade for two years, one year in fourth grade, and the current year in fifth grade. The group of students she is working with this year were her students during her first year of teaching and she looped up with them from fourth to fifth grade. Therefore, she is very familiar with their strengths and weaknesses in academic skills.

Since she is responsible for teaching the math and science curriculums to the entire group of fifth grade students, Sarah has her room set up in six sets of four student desks facing each other. She has an overhead projector and screen as the central focus for the students while her teacher desk is in the back of the room. She also has a small round table and a kidney bean shaped table as well. Her walls are decorated with student work from a water cycle activity and two word walls that contain words for math and science. On her white board she had her activity expectations for behavior and a section for homework assignments. She does not have a lot of displays or equipment present in the classroom for students to see. She does have three computers available for students to use.

First Interview Viewpoints

Planning and Collaboration

Because Sarah is the only science teacher in her grade level, collaboration with her co-teacher is limited to exploring ideas for integration of

science and other subjects. Sarah collaborates with other grade level teachers for her science lessons as she explains, “I get so many great ideas from other teachers.” Before teaching a unit, she went to a colleague who “explained to me what a Newton was because my mind just could not wrap it around … I would have to go to help myself just to make sure I knew what I was talking about.”

Active Learning

To Sarah, active learning means that

> the kids are up, they are moving, they are doing, they are questioning and following through on those questions. They are not just sitting there and listening nor are they sitting there doing experiments out of the book where everyone gets the same results and everyone learns that same exact thing. They are doing things in which they are seeing the differences and what can happen and the changes in science. And when questions arise they are able to learn from their questions, because I think that is where they learn best.

Teaching Science Lessons

Sarah affirms that “science is not written in text, science is in the world around you.” Therefore, her lessons are developed so that students learn the science concepts by “doing,” and they internalize the knowledge. For example, “I can say, it takes more foot force to push a bookshelf than it does to push a book and they could realize that but until they try it they do not feel it.” Sarah taught Newton’s Laws by developing hands-on activities. “I got a skateboard and brought it to school and showed the children what happens when a force acts on a moving object. I went flying and of course they loved that.” To demonstrate Newton’s Third Law of Motion, she completed

experiments with a balloon with the entire class. Each student taped a balloon to a straw and attached it to a piece of string. Students witnessed that the balloon moved in the opposite direction compared to the direction of the air leaving the balloon. Sarah combined the hands-on activities with note taking. She requires students to write the technical definitions to vocabulary words and then write the definitions in their own words to better understand them. Sarah explains a concluding activity for the unit.

> We used the six simple machines we studied to build an object machine that projected a ping pong ball. Then we had to measure how far the ping pong ball went. Using our numbers from our measurements, and time it took for the ball to start and stop we figured out speed. We worked through some math problems with acceleration and force. Lots of hands-on and lots of math integration.

In her weather and climate unit, a great deal of writing was integrated in the science lessons. After viewing lessons on the laser disc and learning about the symbols used on a weather map, the students went outside and did some cloud watching. When her students returned to the classroom, they completed some writing assignments using skills they learned for imaginative narratives.

Second Interview Viewpoints

Collaboration

Sarah adamantly admits that collaboration in a professionally focused way "has just completely changed" the way she teaches. "I am more willing to go out and ask for help and ask for resources. I feel that my kids have learned

more this year than they have in the past. There is just no comparison." She continues,

> Before, I worked with two teachers who are fairly new [at the school] … I would struggle to come up with ideas. I would go on the internet, but I would never see how things would work, and so I would try things, but I would never feel very successful with things. Now, I've got almost like support and if I have a question, I know that I can pick up that phone and call that person and say OK, what do I do? Or, why didn't that work? What can I try? It makes my teaching more successful for the kids, because I am clearer in what I am doing, and they are getting more out of it.

Sarah is willing to ask other teachers for assistance to gain a better understanding of the concepts she has to teach. Before she would go and ask specific questions, now she is asking for ideas and why.

Evolution of Teaching throughout Study

During Sarah's interview, she described a classroom with lots of activity and excitement. However, through observations, she was using the textbook and whole group teacher directed teaching methods with a lot of passive learning taking place from students. The students were not actively engaged in the science content until observation #6 (see table 3).

As the planning sessions were conducted, Sarah was very interested in the management of students when conducting active learning. She always wanted to know the how the implementation should look as well as the planning of the strategy. Sarah developed during the study from a very passive science teacher where students would sit and either listen or watch the

information into a teacher who encouraged students to have choice and creativity to understand the science topics.

Summary

Being the only teacher in the study who was the only science teacher at her grade level, Sarah was isolated in her planning. She also was struggling with knowing who and where to go for ideas or materials. Throughout the initial observations, she was not generating lessons that were active even though she knew what active learning was by definition.

Sarah had worked with a few of the research team members as grade level partners. In the past, the collaboration had been "basically nothing but having the same topic at the same time and that was it." It was "great to see them reaching out and seeing how they could benefit from the entire team."

Research Team Evolution

Planning Sessions

The research team initially began the study by listening to a summary of the information shared from the first set of interviews. Team members shared their ideals of how science should be taught. I then shared the *National Science Teaching Standards* which described in detail how the team members wanted to teach science. We explored what was preventing the team from teaching the way we wanted to every day for every lesson. It was discovered that lack of materials and knowledge had seem to control the teaching methods the most.

Through the next few planning sessions, the team discussed the science topics that still needed to be covered in each grade level and brainstormed ideas of how to teach the concept. Through these discussions, each team member share ideas or comments on how an idea may or may not work in the class. The conversations were led by the research leader for the first three sessions. However, by session four, other team members took the lead for the discussions by bringing up lessons that they had tried or wanted to gain ideas on. The units of study began to form by session five and were completely outlined by session seven. The units of study implementation started after session ten and were completed by session fifteen.

Units of Study

During the planning sessions, a unit of study was created for each grade level. Each unit of study was the integral part of the entire study because its development and implementation was the study's research action. As an entire research team, we debated, collaborated, discussed, and designed each unit. Even though only a few members of the team were going to actually implement each unit, the entire team took some active role in the process. Each teacher identified his/her next topic in science that they were going to study. Then, the team brainstormed various concepts and activities related to that topic. The team members then researched and gathered ideas about the brainstorm ideas to share with the group at the next planning session. Once all ideas had been shared, the team decided what lessons and activities to actually prepare to

teach. At this point, we divided into grade level partners (with the 4th and 5th being a three person group). The partners designed a timeline for implementation and explored what materials we needed to gather and where to get them. Finally, after everything for each lesson in each unit was prepared, the partners implemented the units of study.

The team members created units on the life cycle of butterflies for kindergarten, plant growth for third grade, electricity for fourth grade, and an Earth Day project for fifth grade. Throughout the planning, the team eliminated the barriers of lack of resources and materials, knowledge, and lack of manpower as I describe in detail below.

Butterflies

Hannah and Kelly implemented a unit on the life cycle of butterflies. The lessons included learning the parts of a butterfly by using manipulatives to create a butterfly. The manipulatives consisted of playdoh, string, and straws. They also learned about parts of a caterpillar and read books about caterpillars. The science lessons continued with a set of centers where the students journeyed through a series of four activities. The first was a video and listening center where the students viewed the "Change of Life." Another was the writing of a story using the prompt 'Where would I go if I were a butterfly?' The next center used the letters in the words 'catepillar' and 'butterfly' to create new words in a word building activity. The last center was sequencing a series of pictures that showed the life cycle of a butterfly.

The final stage of the unit was the creation of a butterfly garden and hut within the classroom. The kit was purchased from a local butterfly garden and the owner came in to share what he does as a butterfly gardener. After all the butterflies had hatched, the students released them on the final day of the unit as culminating activity.

Plants

Braelyn and Jill implemented a unit on Plants. In order to maximize our resources, this study was linked with a local agriculturally focused university that wanted to work with elementary students. Braelyn and Jill worked with the contact person to coordinate a series of lessons that would lead into a trip to the university farm. While at the farm, students experienced how plants are important to humans and to the environment. They also learned about the food chain and how it was linked to plant growth as well. Following the trip, students explored and cultivated their own project on plants.

Electricity

Olivia and Jack implemented a unit of study on electricity. The two teachers had the same lesson objectives but the methods employed to teach the objectives were different. Olivia used task cards and materials to have the students create electrical circuits. The students had to follow the directions step by step to get the light bulb to work during each task. Jack accomplished this same objective by giving the students the materials without task cards and challenged them to find as many ways to light the bulb as possible. This was an

inquiry lesson. He gave them sentence strips to complete while they were exploring the materials. The sentence starts were “I noticed…”, “I found out…”, “I wonder…”, “What if…”, and “I’d like to try…” After the exploration, Jack gave students the opportunity to share their ideas of how they got the bulb to work.

To complete the objective about conductors and insulators, Olivia conducted a whole group lesson that was using the textbook and vocabulary words followed by a lesson discussion about what materials would conduct or insulate electricity. To conclude the unit, Olivia prepared an activity in pairs to create electricity by using those materials. Jack accomplished this objective by creating a project. Students were to create a flashlight or a noise maker by using specific materials given such as: bulbs, wire, potatoes, lemons, oranges, glasses of water, and more. While the students worked on their projects, Jack would introduce vocabulary and facts about electricity through mini-lessons each day. The culminating activity required the students to demonstrate their projects and experiment with what others had created.

Earth Day

Sarah implemented a unit on Earth Day. She focused on the science objectives on the effects of pollution on ecosystems and recycling. Since Earth Day was on April 22nd, Sarah incorporated a celebration and the meaning of the day into her unit of study. She began her unit with a small group activity where students were reading and researching about pollution. The next lesson was designed to explore recycling and how recycling works in nature as well as the

process not in nature. She designed a hands-on activity using 'trash' to create useful items. The students worked as pairs to complete the next task which was a project. The students were to choose a way to help encourage and promote recycling and end pollution. The students were given a list of ideas or they could create their own idea. The list included making a newspaper advertisement, constructing a powerpoint about pollution, posters to explain recycling, creating a toy or tool out of recycled materials, and many more ideas. The culminating activity included the students presenting their projects to each other at the Earth Day Celebration.

Chapter Summary

Each team member participated in two interviews. Their viewpoints revealed patterns around planning, collaboration, the meaning of active learning, and descriptions of science lessons. The research team experienced very similar feelings when asked how the collaboration in planning sessions helped drive their science instruction. All team members stated that the planning sessions were beneficial to them as professionals.

Observations were conducted for ten weeks during this five month period. These observations were also used to describe the classroom environment for the participants. During the planning sessions, participants shared views and ideas that were documented to acquire information on the process of the action research. When analyzing the data from Chapter III and IV, I investigated to find patterns and trends. In the next chapter is an

explanation of my findings from the data analysis. This chapter describes the recommendations and implications for further research.

CHAPTER V

FINDINGS AND IMPLICATIONS

The data from the observations and the interviews of the seven classroom teachers have been compared to the "teachers of science" described in the *National Science Education Standards* (National Research Council, 1996). This chapter contains my data analysis across each case study. The findings from the analysis support the recommendations at the end of this chapter.

Summary of Research

The primary purpose for this action research study was to explore an elementary science program and find ways to support science education as an administrator of an elementary school. The study took place in a large suburban school system in the southeastern United States. Seven teachers at a small rural school volunteered to participate in the study. Each participant became an active member of the research by determining what changes needed to take place and implementing the lessons in science. My study also focused on teacher collaboration and how it influenced science instruction. The data collected included two interviews, ten observations of science lessons, the implementation of four science units, and informal notes from planning sessions over a five month period. The questions that guided this study were how do teachers prepare to teach science through active learning and how does instruction shift as a result of teacher collaboration.

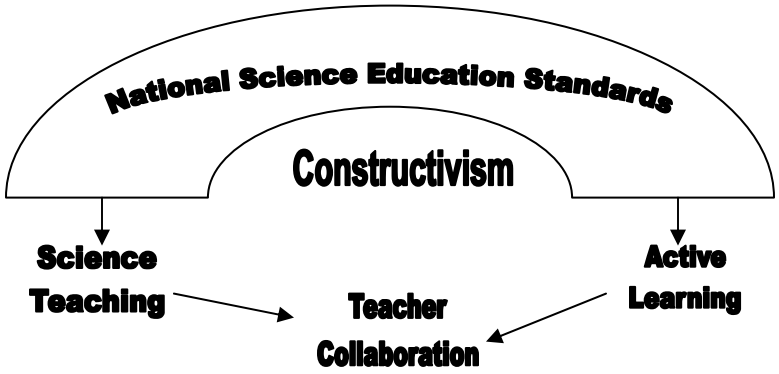
Using my review of the literature, I designed a conceptual framework to analyze the data collected from this study. The framework is centered on the *National Science Education Standards* that were issued by the National Research Council in 1996. The seven research team members and their practices in teaching were compared to what the National Research Council (1996) advocated as best practices by "teachers of science."

Using a participatory action research design, I developed a case study of each team member as a basis for analysis and then cross analyzed to compare each member. Through a five month period, the research team, including myself, collaborated and developed a community of professionals focused to change science instruction.

Framework for this Study

The framework of the study uses the *National Science Education Standards* to create a comparison for teachers of science in the nation are being held accountable to do. These Standards address not only science teaching, but also active learning and teacher collaboration to enhance the learning of students.

Figure 2: Conceptual Framework



The National Science Education Standards are a component of the framework that connects the science teaching practices and the active learning strategies. Teacher collaboration is the method I believe the literature supports that will enhance teaching and learning. As stated in Chapter 2, the Science Teaching Standards focus six strands of teaching and the conceptual framework incorporates teacher collaboration to inform the science teaching and active learning components.

Results

Table 4 demonstrates the style of teaching that I observed during each observation. The first five observations occurred prior to the full implementation of the action to overcome the barriers of lack of resources, knowledge, and manpower.

Table 4: Observation Data Collected Prior to Action Implementation

	Obs #1	Obs #2	Obs #3	Obs #4	Obs. #5
Jack	Graphic Organizer	Coop Learning	Pairs	Coop Learning	Small Group
Olivia	Whole Group	Whole Group	Seat Work	Whole Group	Whole Group
Hannah	Small Group	Discussion	Centers	Whole Group	Small Group
Braelyn	Small Group	Whole Group	Small Group	Pairs	Whole Group
Jill	Small Group	Video	Whole Group	Small Group	Video
Kelly	Discussion	Small Group	Centers	Whole Group	Discussion
Sarah	Whole Group	Whole Group	Whole Group	Seat Work	Whole Group

Table 5 indicates the style of teaching that I observed during each observation after the action was fully implemented.

Table 5: Observation Data Collected After Action Implementation

	Obs #6	Obs #7	Obs #8	Obs #9	Obs #10
Jack	Experiment	Manipulatives	Project	Manipulatives	Experiment
Olivia	Manipulatives	Pairs	Whole Group	Discussion	Pairs
Hannah	Manipulatives	Centers	Pairs	Manipulatives	Experiment
Braelyn	Cooperative Learning	Experiential	Centers	Project	Project
Jill	Cooperative Learning	Experiential	Centers	Project	Project
Kelly	Manipulatives	Centers	Pairs	Manipulatives	Experiment
Sarah	Small Group	Manipulatives	Pairs	Project	Presentation

When comparing Table 4 and Table 5, the activity focus for each lesson changed from more whole group and small group settings to manipulatives, projects, and collaborative pairs. I believe these changes were due to the lessons that were designed by the research team. The grade level partners developed lessons with the research team that incorporated active learning methods.

The next set of data (Table 6) I compiled reveals the growth in active learning throughout the research study. Out of my 10 observations of science lessons, the following activities occurred:

Table 6: Comparison of Activities

Activity	Number of Occurrences Prior to Action	Number of Occurrences After Action
Manipulatives	0	9
Video/Film/Audio	3	0
Small Group	10	2
Seat Work	2	0
Centers	2	4
Lecture	1	0
Projects	0	7
Discussion	3	1
Collaborative Pairs	2	6
Whole Group	13	1
Presentations	0	2
Cooperative Learning	2	2
Experiment	0	4
Experiential	0	2
Graphic Organizers	1	0
Game	1	0

Table 6 indicates an increase in the use of manipulatives, creating projects, and student collaborative pairs and the incorporation of presentations, experiments, and experiential activities. I believe this table exemplifies the types of teaching methods used prior to the implementation of the action which was majority whole group instruction. It also shows the shift in instructional methods when the action was implemented.

The Research Team Compared to Standards

In table 7, each standard is defined with my interpretation based on the review of literature and my past experiences. I examined the data from the observations, interviews and my planning session log to determine what symbol represents how each team member relates to each of the Science Teaching Standards. Therefore the ratings are subjective judgments. However, each participant reviewed Table 7 to also provide their input. During the final team session, participants were given a blank table to complete as part of their reflection. Then a dialogue occurred as a team about how the team performed on the table. The team members participated in the construction of a formative assessment of their own teaching practices compared to the Standards. Together, we decided which symbol best represented the description.

Table 7: Standards Comparison Chart

Science Teaching Standard	Jack	Olivia	Hannah	Braelyn	Jill	Kelly	Sarah
1: Teachers of science plan an inquiry-based science program for their students.							
• children can explore and inquire	S	X	S	A	X	S	S
• activities are relevant and meaningful scientific themes	A	S	A	A	S	A	A
• children clustered in groups	A	X	A	A	X	A	A
• Children work together to identify and solve problems	S	X	S	S	S	S	S
• Not passively or individually acquiring information	S	X	S	S	S	A	S
• children are active inquirers	S	X	S	S	X	S	S
2: Teachers of science guide and facilitate learning.							
• teacher as the facilitator of group activities	S	X	S	A	S	A	S
• planning lessons focused on children's interest	A	X	A	A	A	A	A
• activities focused on children's interest	A	S	A	A	S	A	A
• experiences focused on children's interest	A	X	A	A	S	A	X
3: Teachers of science engage in ongoing assessment of their teaching and of student learning.							
• Actively reflects on practice	A	A	A	A	A	A	A
4: Teachers of science design and manage learning environments that provide students with the time, space and resources needed for learning science.							
• access to a wide variety of equipment and materials	S	X	S	S	S	A	X
• children actively engaged in materials	S	X	A	A	S	A	A
• classrooms rich with natural phenomena	X	X	S	A	S	S	X
5: Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning.							
• student-centered classroom	S	S	A	A	S	A	S
• encourages critical thinking	A	S	S	A	S	A	S
6: Teachers of science actively participate in the ongoing planning and development of the school science program.							
• encouraged to work with parents, community, and other teachers to develop quality science lessons	A	S	A	A	A	A	A

The symbols refer to the amount of evidence seen through observations and interviews to support each description based on the National Science Education Standards.

A=always S=sometimes X=not observed

Standard 1: *Teachers of science plan an inquiry-based science program for their students.*

Jack, Hannah, Braelyn, Kelly, and Sarah were very similar in their ratings in this category. The data revealed that on some occasions when teaching science these teachers allowed children to explore and inquire, work together to solve problems, and have activities that were relevant and had meaningful scientific themes. However, Kelly was the only teacher who consistently taught in a non-passive and individualistic manner. Her teaching style for all subject matter, including science, was to place students in small groups and centers.

Most of the team members clustered their students into groups for science teaching. Olivia and Jill were the only teachers who had a room arrangement with rows of desks. In addition, Olivia proved to be the most resistant to creating an inquiry-based science program for her students. I was unable to find any evidence to show how her teaching was aligned with this standard except for the unit of study that occurred due to the planning sessions.

Over the course of this study, the participants engaged in professional development opportunities such as the demonstration lessons by Jack. These opportunities provided growth in this standard by allowing the teachers to not only witness how to teach actively but to also participate in those lessons. During the creation of the units of study, the teachers actively practiced the skills or research information to be confident in the teaching.

Standard 2: *Teachers of science guide and facilitate learning.*

This standard was a strength for the entire research team with the exception of Olivia. The teachers felt comfortable and confident in the development of the lessons, activities, and experiences focusing on children's interests. Braelyn and Kelly stood out as the true leaders in this area as they enjoyed assisting in others' lessons during the implementation of the action.

Braelyn's demeanor with the students was very coach like. She constantly encouraged them to try new things or ideas in the lessons. She replicated this behavior during the planning sessions with team members. Kelly was a cheerleader for the entire study. She began the entire project by enlisting more participants and encouraging them to try something new. The other teams members seemed to understand the practices of facilitating instruction instead of constantly being the provider of the information. However, Olivia was reluctant to give up her teacher-directed style of providing students all the facts and details and then following up with an activity.

Standard 3: *Teachers of science engage in ongoing assessment of their teaching and of student learning.*

During the conversations at the planning sessions, the teachers continually discussed the effectiveness of their own teaching and resultant student learning from this process in the study. Hannah commented that her "students have benefited from this study because I feel I am a better teacher now." However, there were no formal assessments given throughout the project;

instead, teachers informally assessed students' learning by monitoring their progress in the activities and asking them questions. They also designed projects and presentations that revealed whether students understood the concepts.

Standard 4: *Teachers of science design and manage learning environments that provide students with the time, space and resources needed for learning science.*

This standard was one that initially was the most challenging. Middleton Elementary School has a limited amount of science equipment and materials. Thus, the research team developed the plan to overcome this barrier to science instruction by ordering the materials and equipment needed to teach the units of study. For the kindergarten unit, we needed butterfly kits so the students could explore the life cycle of the butterfly. For the third grade unit on plants, we needed the tools and materials for planning seeds and space for them to grow. For the fourth grade unit, we needed electrical circuit supplies such as batteries, bulbs, and wires. For the fifth grade unit, we needed access to various experts and research on recycling; therefore, we purchased resource materials.

Once all the issues with the lack of materials and resources were overcome, it was the actual classroom teacher who had to allow student access and encourage student engagement with the materials. With the exception of Olivia, the team members embraced this standard with excitement to share these items with their students. As Jill exclaimed, "I have never seen my kids so enthralled with something this year, but they really have made the connections

from the experience at the farm to the activities we have conducted here at school." This study revealed to me and the team that the materials and equipment at Middleton Elementary would need to be updated and renewed in order for this type of teaching to continue.

Standard 5: *Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning.*

Even though most elementary teachers believe they are allowing students to think critically and analyze carefully, it is rare that K-5 teachers actually reach the critical analysis and generating phases in the higher order thinking skills (Marzano, 1988). Each team member experienced the upper levels of thinking skills with their students during the units of study. Jack, Braelyn, and Kelly explored the critical thinking components during each observation and described these lessons in their interviews. However, Jack and Olivia did not have student-centered classrooms. Jack's room was full of teacher generated materials and a display of his favorite things and Olivia's room was very stale and unchanging.

Standard 6: *Teachers of science actively participate in the ongoing planning and development of the school science program.*

The action research study actively encouraged each team member to achieve this standard. A majority of the team members embraced this collaborative effort with enthusiasm. When evaluating this standard, I was using the Experiential Learning Cycle to examine the data. The cycle begins with an

experience. The research study in general was the experience for all team members including myself. During each planning session, we reflected and shared our thoughts about the experience with each other. Then, we generated our thoughts and plans of action based on our reflections. Finally, we applied the plans of action to begin a new experience. This cycle was repeated many times through the study. Through the teacher collaboration and the process of the learning cycle, the team grew to trust each others ideas and attempted to take risks in their teaching.

Throughout this study, the research team and I worked together to solve a problem-improving science teaching. By solving this problem, we analyzed our data that had been collected to critique ourselves and to attempt to find the problems that needed to be solved. Through this process, we developed great units of study that engaged our students at Middleton Elementary. This process of action research gave the participants the time, place, and opportunity to collaborate and focus on student learning as a professional community. Additionally, the study gave the team members the leadership skills and confidence to work with others and to share their knowledge. By having this opportunity for action research, each participant had a shift in their instructional thinking and methods towards the constructivist type of active learning and teaching approaches. The team members can construct their own practice for improvement.

Findings

The findings, presented as patterns within the data, are summarized below.

Planning

Prior to our action research, the participants primarily planned in isolation with the exception of Braelyn and Jill. However, Jill relied on Braelyn for all of the science lesson ideas. Most participants created textbook driven science lessons or lessons centered on the few resources they had. Due to the lack of resources the lessons tended to be whole group or teacher directed. Even Olivia expressed during her first interview that she had taught for a long time and admitted that she did not do a lot of planning.

During the action research, the participants planned science lessons as a team of teachers brainstorming and discussing ideas. The research team designed the units of study as a group and thus cross-grade level and vertical teaming occurred. The team supported each other by being in each others classrooms to help implement the activities.

The materials and resources were not an issue; therefore, the lessons tended to be hands-on or cooperative in nature. Braelyn expressed during the second interview that she thought Jill would be better now at planning science lessons and being a contributor to their planning sessions in the future due to this research experience.

Active Learning

Prior to the study, the research team defined active learning as learning by doing. During the action research, the research team gained knowledge about other types of active learning such as inquiry and project based. Team members understood that it is what the teacher guides the students to learn from the "doing" that makes it active learning. Each team member attempted to teach in different ways and methods than they were teaching prior to the study.

During this research, Jill incorporated more cooperative groups into her science lessons. This type of learning allowed her to engage her students in the topic. Hannah expressed during the second interview that her opinion of active learning has grown. She did not realize how many ways of teaching could be considered active learning and if a teacher modifies what they are currently doing could be active learning as well.

Collaboration

Prior to the study, each team member described collaboration as a discussion or time to talk about plans and students. Team members, during the action research, were entrenched with the collaboration of a professional community. They described how they trusted each other and were willing to take risks in their teaching due to the support of the team. Each team member, with the exception of Olivia, actively participated in the planning sessions. Olivia was not as expressive or positive about the ideas generated during planning sessions.

Jack states that collaboration is not just about resources but about the sharing and focus on student learning that is important. Olivia and Jack are co-teachers who teach at the same grade level. However, very little collaboration existed prior to the study and still did not exist after the study. Olivia was the negative proof for the action research project. This means that even though she was not actively a part of the discussions and not positive about every idea, Jack benefited from participating with the others instead of being alone as her partner. Olivia also benefited by hearing the discussions and attempting a few of the lessons or modifying the lessons to her comfort level.

Instructional leaders should build a professional culture centered on the collaboration of teachers focused on teaching and learning. This project using collaboration required an administrator who would support the collaboration and provide the structures that are necessary for its success.

It is crucial to note that Olivia was a negative case for this study. Even though she volunteered to participate, she did not participate as actively as the rest of the team or engage in the lesson planning as positively. However, she helped the action research study by making efforts to change her teaching and use active learning methods somewhat based on the observations throughout the study. Her collaboration with the team was minimal but she was present at every meeting and thus heard the discussions that took place. Her instructional paradigm will take more time to shift dramatically but is leaning more that it did in the beginning of the study.

National Science Education Standards

Prior to the study, the team members could not have been identified as meeting the science teaching standards due to one or more of the standards not being addressed. There was no definitive measure to make this assumption. However, at the conclusion of the study I designed an assessment matrix (see table 7) that ranked team members by the Standards. Braelyn and Kelly matched 12 components of the science teaching standards making them the strongest team members according to the *National Science Education Standards*. Jack and Hannah had 7 matches while Sarah followed with 6. Jill and Olivia were the fewest matches with 2 and 0 respectively.

How does teacher collaboration influence teacher preparation for active learning in science?

Teacher collaboration allows teachers to work together to plan and implement lessons for active learning in science. The research team planned a series of lessons to implement during each unit of study. The units were not designed only by the grade level teachers but resources and ideas as well as lesson creation was provided by all team members. Thus, teacher collaboration positively influences teacher preparation for active learning in science.

What strategies do elementary teachers currently use to teach science?

The research revealed that most teachers in the study were textbook driven teachers who depended on the textbook to give them ideas and knowledge about the subject to be taught. After the study was complete,

teachers were using active learning strategies and collaborating with each other to design science lessons.

How do elementary teachers prepare for teaching a lesson in science?

Prior to this study, teachers prepared for teaching a lesson in science by acquiring the knowledge, lesson, and materials list from the textbook. After the action research, the participants are working with each other to design lessons that are not directly from the textbook but from other resources or created by the team. They also explored the concepts of active learning to determine the methods they would incorporate in the lesson.

How has teacher collaboration shifted the instructional paradigm?

The instructional paradigm shifted within the research team from textbook teaching to active methods. I believe this study indicated how teacher collaboration and action research will promote teachers confidence and knowledge to have the ability to teach and engage their students in active learning.

Implications

Based on my interpretations of the data gathered for this study, I suggest the following implications. The implications are prioritized based on my interpretation of their importance to the body of knowledge concerning elementary science teaching.

1: Teacher Collaboration

Throughout this study, teacher collaboration was a key element to increasing the use of active learning methods. The study not only encouraged collaboration but forced the teachers to become partners in the teaching of science across the entire school. I believe that when a community of professionals can focus their dialogue on the best practices in teaching to benefit students the end results of the dialogue will be excellent ideas for lessons. The team members learned to trust each other and to open up with their anxieties about teaching science. After the units of study began, team members reflected during the planning sessions to determine what to modify in the unit or where a new idea may be developed. Jack's demonstration lessons were integrated into the study due to a conversation that took place early in the study. Hannah had expressed how she was not sure how an inquiry lesson looked and how a teacher facilitated the lesson. From that discussion, Jack offered his classroom activity to be observed by the team. The openness by team members grew throughout the study. True teacher collaboration develops when participants let down their guard and reveal their fears to the group. This allows the group to reflect, support and bounce ideas off of each other for lessons in a way that each member can benefit.

2: Overcoming Barriers

The planning of science lessons requires teachers to think about resources, materials, knowledge and manpower to accomplish the goals of the

lesson. Prior to the action part of the research, all of these were barriers to the teaching of science at Middleton Elementary. As a team, we overcame the barrier of resources and materials by purchasing the equipment and supplies that the units we designed required. We explored ways to increase the manpower in the classes while science instruction was taking place. By developing a schedule, each team member supported each other. The area of knowledge was the hardest barrier to overcome. Literally, team members had to tutor each other to gain the knowledge they felt they needed to effectively teach the science lessons. Most teachers felt they had the basic knowledge but they did not have the extensive information that students wanted to know about the topic.

Once we overcame the barriers of resources, knowledge, and manpower, the lesson planning opened a window of opportunity for the teachers. The excitement grew to develop more lessons using the new tools and knowledge. By the end of the study, we determined that we did not need an extra person during every lesson. Instead, we concluded that only when we were constructing or actively manipulating materials were extra persons needed.

3: Active Learning

Active learning is found in many different forms. In many ways, this research study was a type of active learning for the research team. We explored many different ways of hands-on, inquiry based, experiential, and cooperative learning methods just by participating in this study. The study as a whole was an experience that developed into many more experiences in which we continually

reflected and generated new ideas to apply to the next experience. By creating these same opportunities for our students, we developed units of study using methods of active learning.

Some lessons integrated many learning styles and teaching methods. While some team members chose to develop interdisciplinary units that used active learning not just in science lessons. All of these experiences allow the team to take risks in their teaching. Some of the lessons were very successful while others bombed completely. However, the importance of active learning is to demonstrate the ability to keep going and search for the best answer. I conclude that active learning must be a part of all science teaching programs but the teachers must have the support from other teachers to have the motivation to continue and the support of having the materials and resources to design and implement the lessons.

Recommendations

The following recommendations for elementary school administrators are:

- Teachers should be allowed the opportunities to develop into a professional learning community that is focused on the improvement of teaching methods for the entire school. It cannot be forced to occur but rather structured to take place. In my action research study, teachers created a professional learning community centered on student learning and being strategically focused on science. Each participant collaborated to implement units of study and to support each other to ensure the units success for the students.

- Administrators should allow the teachers to create a list of the equipment and materials needed for science instruction. Once the initial list is purchased, the equipment and materials need to be maintained and stored in a central location in order for all teachers to benefit from the resources. One would think that this would be a simple task of administrators; however, in the age of accountability testing, science equipment and needs have been neglected and thus will need to be addressed. Throughout the study, the team identified the equipment and materials needed for the science instruction. As the research leader, I found or purchased each of those items in order to help the implementation of the study. Materials and equipment should not be a reason to not teach science and it is a barrier that is easily overcome.
- Another recommendation is to help elementary teachers gain the knowledge and confidence to teach science actively. This can be accomplished by implementing professional development opportunities within the school by having experts share during development days or by having teachers who are experts at the school share their best practices. Teachers must be encouraged to take risks in their teaching of science and gain the ability to meet the *National Science Education Standards*. During my research study, participants demonstrated lessons and tutored each other to gain the knowledge about a concept. Since most elementary teachers do not have degrees or concentrations in science, they need to be given the opportunity to learn the concept and feel confident to teach the concept to students.

- Action research should be conducted by groups of teachers at all schools to address areas of concerns or areas that need improvement. This can be encouraged by the school administration by allowing teachers to take the risk to collaborate and try new things in teaching. However, action research allows all the participants to be involved in the decision making and the implementation of the action. In my study, action research was the type of methodology used. This type of research allowed the teachers to become immersed in the topic of science teaching and learning and to help problem solve. This study went through the complete process by collecting data to find the problems around the topic, analyzing and discussing the data to determine actions to take, implementing the actions, and reviewing the outcomes for further actions.

Implications for Future Research

With the new science component of the No Child Left Behind act quickly approaching, I propose that this study be replicated on a larger scale. I think a large research team could develop teams of teachers and administrators at various schools and then compare the data between the schools. Once test results are provided, the research could also continue with an investigation that included two schools--one school teaching actively and according to the National Science Education Standards while the other school teaches science using the textbook driven method. It would be interesting to see which school performed better on the state exam.

Action Research Reflection

An underlying theme to my study was to enhance my instructional leadership by using action research. A key function of school leadership is to influence the practices of teaching and learning. While teachers assume responsibility for practices within the classroom, often administrators work on school-level conditions such as controlling the conditions for students and staff in common areas. They buffer teachers from external interferences and interruptions. School cultures are developed to reinforce the behaviors of students and staff to support the learning. However, instructional leaders focus on the improvement of instruction to support the safe and orderly classrooms and culture. It is more than just management of a building. By participating in this study, I gained the opportunity to be seen as an instructionally focused person. It gave me the credibility with the research team and other staff members at Middleton Elementary that was necessary to lead curriculum and instruction.

Professional communities reflect ability for a school to engage in and act upon a shared understanding of practice. Strong professional communities in schools that promote collective responsibility for student learning and norms of collegiality among teachers are associated with higher levels of student achievement. Through development of a shared understanding of the abilities and constraints of existing instructional practices, a school's professional community provides the capacity for collective action in the improvement of teaching and learning. Using action research as a leadership tool, I created

structures that build and sustain relational trust around the issues that are vital to instructional improvement. This tool coupled with a Professional Learning Community allowed me to be in the loop for quality feedback, provide teacher empowerment and leadership, and be accountable for principal practice as an instructional leader.

Action research is an instructional leadership tool that was used in this research study to examine science teaching and learning. A team of seven teachers and I explored our views on science teaching and learning to realize the barriers to teaching science in the active manner that we wanted. The barriers that were addressed in my study were lack of resources and materials, lack of knowledge, and lack of manpower. The research team used teacher collaboration to design and implement four units of study centered on science concepts from the Standard Course of Study. By exploring science teaching and using teacher collaboration, each participant gain skills and knowledge to be a better science teacher and thus a more active learning environment was created.

Instructional leaders work with teachers to improve instruction instead of dictate or mandate particular methods of instruction. As an instructional leader, I was able to participate in the study and aid teachers during the implementation of their lessons. By having a more participatory study, my research enhanced my growth as a principal. The quality of science instruction at Middleton Elementary was improved during the research study and thus the school is well on its way to meeting the proficiency standards that are expected in 2007-2008. By building a

professional community of teachers, my research project allowed Middleton Elementary to improve teaching practices and to allow teachers and administrators to work together with an instructional focus.

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Appendix A: Observation Form

Science Lesson Observation Form

Teacher: **Date:**

Instructional Environment:

____Beginning of Lesson
____Middle of Lesson
____ End of Lesson

____Students are actively engaged in lesson
What are they doing?

____Teacher is engaged in instruction
What are they doing?

Class Activity:

___Aligns with planned lesson	___Demonstration	___Manipulatives	___Centers
___Video/Film/Audio	___Small Group	___Seat Work	___Lecture
___Whole Group	___Research	___Projects	___Discussion
___Collaborative Pairs	___Presentations	___Computer Lab	___Game
___Cooperative Learning	___Experiment	___Experiential	
___Graphic Organizers	___ Other: _____		

Lesson Description:

Physical Environment:

Describe:

Appendix B: Interview Protocol

First Interview Protocol

- Getting started
  - Describe how you teach science.
    - What is the most current topic that you have taught in science?
    - Explain a few of the lessons that you used to teach those concepts.
    - What do you have to do to get ready to teach lessons in science?
- Perceptions
  - Is this the ideal way you want to teach science?
    - If yes, why?
    - If no, why not?
  - What makes you not able to teach the way you want to teach?

- Affects of collaboration
  - What does the term active learning mean to you?
  - Do you collaborate with colleagues to plan your teaching?
    - If yes, why?
    - If no, why not?
  - How has teacher collaboration influenced your teaching?
  - How has teacher collaboration shifted your thoughts about good teaching and methods?

Second Interview Protocol

How have your views changed about teaching science and teacher collaboration?

Appendix C: Consent Form

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

CONSENT TO ACT AS A HUMAN PARTICIPANT: LONG FORM

Project Title: A Study of an Elementary Science Program: How teachers prepare for active learning

Project Director: Sara Roberts

Participant's Name: _____

DESCRIPTION AND EXPLANATION OF PROCEDURES:
I am a student in the Guilford County Schools cohort in the Doctoral Program of Educational Leadership at the University of North Carolina at Greensboro. I have been a science teacher in grades 6-8, an assistant principal at elementary and secondary levels, and a principal. I am currently an elementary school principal.

The final requirement of this program is the dissertation. This study will gain the perspective of teachers on how they currently teach science in an elementary classroom. Interviews with teachers will provide insight into the lessons and methods of teaching that have worked. The interview will also explore what lessons and methods of teaching that the teachers have not used and why. This action research will involve teachers working together in making changes in teaching and learning.

RISKS AND DISCOMFORTS:
The participants are elementary school teachers. Interviews are designed to last approximately 60-90 minutes. Each participant will participate in two interviews and weekly observations of science lessons. The long form will be used to allow participants to have a copy of the purposes and procedures involved in the study. In the case that a participant should desire to withdraw, he/she will be able to do so without penalty. The data collected from that participant will be destroyed immediately.

The teachers who will participate in this study should feel free to express their honest opinions about the styles of teaching they use in science and the ways they prepare to teach a science lesson. There will be no psychological or sociological risks. Precautions taken will include: insuring participants of the purpose of the study, maintaining a non-threatening, safe environment for the participants during the interview, establishing a positive rapport with the participants to insure a clear understanding of how data will be used. Pseudonyms will be used to protect the identity of teachers who are interviewed. There will be no identifiable characteristics used in the narratives. No data collected as part of this research study will be used in employment evaluations. Audiotapes and notes will be maintained for three years in a locked file and then destroyed by shredding of written documents and erasing of audiotapes. The level of risk for participation would be described as “no risk.”

POTENTIAL BENEFITS:
The intent of this study is to contribute to the understanding of teaching and learning in elementary science. This understanding will help explain the barriers to various teaching methods in elementary school science program. The individual participants may experience some benefit from the one-on-one interaction with the researcher and gain an opportunity to reflect on what they can do differently in their teaching of science. By participating in action research, participants will be able to improve the teaching and learning in their school.

CONSENT:
By signing this consent form, you agree that you understand the procedures and any risks and benefits involved in this research. You are free to refuse to participate or to withdraw your consent to participate in this research at any time without penalty or prejudice; your participation is entirely **voluntary**. Your privacy will be protected because you will not be identified by name as a participant in this project.

The University of North Carolina at Greensboro Institutional Review Board, which insures that research involving people follows federal regulations, has approved the research and this consent form. Questions regarding your rights as a participant in this project can be answered by calling Mr. Eric Allen at (336) 256-1482. Questions regarding the research itself will be answered by Sara Roberts by calling (336) 884-6077. Any new information that develops during the project will be provided to you if the information might affect your willingness to continue participation in the project.

By signing this form, you are agreeing to participate in the project described to you by Sara Roberts.

_____ _____

Participant's Signature* Date