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THE EFFECTS OF GENDER IN ELEMENTARY SCIENCE GROUPS

by

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B.S. Westfield State College, 1998

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Education
in the Department of Teaching and Learning Principles
in the College of Education
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This action research study investigated the effects of gender on same and mixed gender elementary school science groups. Qualitative data for this study was collected using surveys, student focus groups, student journals, and teacher-researcher field notes and observations. Students in this study were eager to participate in science groups and demonstrated a positive attitude toward the study of science. Results also showed the types of interactions between boys and girls varied and those interactions affected their science attitude and participation. Recommendations were made for continued research to examine the long-term effects of gender groupings in the elementary science classroom.
ACKNOWLEDGMENTS

I would like to thank the third grade students at Riverglades Elementary for sharing their thoughts and insights with me during this study. They provided me invaluable information that guided me in becoming a more effective teacher.

I am delighted I was able to share this experience with such a tremendously talented group of teachers. My experiences with this cohort were unforgettable. I would especially like to thank my advisor, Dr. Jeanpierre, for her patience, encouragement, and continuous support throughout the program.
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CHAPTER ONE: INTRODUCTION

The enthusiasm children feel and the positive attitude they begin to develop as young students is critical in establishing a future love of science learning (Jarvis & Pell, 2002). As an elementary school teacher, I believe it is my responsibility to discover a way to maximize students’ involvement in science class. Although there are a multitude of influences that affect students’ participation in science class the focus of this study was student gender. By identifying which student gender groupings promoted equal and active involvement in science class I hoped to fortify a positive attitude toward the study of science in my students, for the primary years of a child’s education are paramount in establishing academic attitudes and interests (Jarvis & Pell, 2002).

Prior to beginning the study, I anticipated gaining insights on how to improve classroom science experiences for young boys and girls by observing patterns in students’ participation and attitudes while engaged in various scientific inquiries. By researching my teaching practices when working with groups of same and mixed gender students as they participated in small and large group science inquiries I aspired to detect which student pairings promoted the most equal opportunities for participation within the group. Student gender was further examined to observe the role it had in group dynamics as students shared science tools to complete science inquiries. By alternating same and mixed gender groups and compiling data on group interactions, I hoped to make inferences, based on reflection of my teaching, that would help students reach their personal best learning experiences.
Purpose

The purpose of this study was to examine my teaching practices involving third grade students’ attitudes and participation during science instruction as students were alternately grouped in same and mixed gender teams. Using data collected during the study on my practice I sought to identify ways to improve my teaching and, in turn, guide students to become active learners who enjoyed and equally participated in science class. By gaining insight on students’ interactions, I hoped to establish a foundation for children to become critical thinkers beginning to understand the basic aspects and applications of science concepts, which should be cultivated in elementary schools (Jarvis & Pell, 2002, p. 980).

Research Questions

This action research study focused on five major questions:

Question #1 What were students attitudes toward science?

Question # 2 During science lessons, what were students’ attitudes while in same-gender groups?

Question # 3 During science lessons, what were students’ attitudes while in mixed-gender groups?

Question # 4 How did students participate in science while in same-gender groups?

Question # 5 How did science participate in science while in mixed-gender groups?

Data for this study were collected using teacher-researcher created attitude surveys, student focus groups, student journals, teacher-researcher field notes and observations. Pre and post surveys previously found to be useful for this study included the Draw A Scientist Test and
Student Science Survey by Pierce (1999). Surveys were used to collect data on students’ feelings and attitudes while grouped in same and then mixed gender groups during science investigations.

**Rationale**

As a novice teacher, my science instruction consisted of reading the science text, defining key terms within the text, and answering comprehension questions based on text passages. As my teaching experience and confidence increased, a desire to improve my science teaching also developed. Gradually, teacher-led demonstrations developed into small hands-on projects for students. My instruction transformed from teacher-led activities to leading students in guided inquiry sessions. Within guided inquiries, students were challenged to discover and justify solutions to teacher-posed, curriculum-based science questions. The shift from text-based instruction to inquiry-based investigations had its challenges, more so for myself than the students, but the benefits of the switch, I believe, have been endless.

I have seen students transform their feelings regarding science instruction from indifference to excitement. A sigh of disinterest at the posting of science in the daily schedule has been replaced with constant reminders, by students, to leave adequate time in the day for science inquiry. As students engaged in interactions, discussions, and sometimes arguments during science investigations, I became curious about the groupings that prompted the varying student involvements with classmates. As I reviewed the data on students’ interactions, I sought information that supported the benefits, or lack there of, students experienced when assembled in single and mixed gender groups so my practice could be modified to support groups that facilitated and maximized student participation.
Utilizing constructivist pedagogy that challenges students to generate their own knowledge, with my guidance, I strive to create a classroom environment free of any threat that may hinder students from reaching their personal best, both socially and academically. I challenge students to generate knowledge based on scientific principles as they participate in guided inquiries in the classroom. By connecting prior knowledge to present experiences students are able to build schematic maps that help them understand the topic at hand (Piaget, 1952).

**Significance of Study**

Teaching science in an ongoing constructivist manner relies on the students to generate ideas and questions based on their own values and beliefs (Alkove & McCarty, 1992). Thus, students’ creativity, enthusiasm, and attitudes heavily affect the outcome of each science lesson. Maintaining a positive classroom environment where students are expected to perform both individually and as part of a group can be challenging. As students begin a new school year with a new teacher and classmates, they require practice, guidance, and encouragement as they begin to explore new ideas and new classroom social norms. Learning-centered classrooms that cultivate a variety of learning experiences allow students to combine their personal ideas and experiences with those of their classmates in an environment where they feel free to take intellectual risks without fear of punishment or taunting (Alkove & McCarty, 1992). “Learning science is something students do, not something that is done to them” (National Research Council {NRC}, 1996, p. 20). The National Research Council (NRC) further emphasizes communication is a critical aspect of the inquiry process (1996). For students to maximize their learning during the inquiry process, they must be able to articulate their thoughts as well as
actively listen and respond thoughtfully to their classmates. Providing students the opportunity to take ownership of their learning by expressing their ideas facilitates understanding of the topic in a manner that makes sense to each individual (Alkove & McCarty, 1992).

Decades before the National Research Council or the National Science Teachers Association supported inquiry, Piaget advocated the need for children to use “discovery of new means through active experimentation” (Piaget, 1952, p. 279). By leading students to actively engage in science inquiry, children better understand science concepts (Atwater, 1996). The NRC suggests from the earliest grades, and regardless of gender, students ought to experience science in an engaging manner that incorporates the active construction and explanation of ideas (1996). To discover ways to increase students’ engagement in science vast amounts of research have been conducted.

Research studying gender equity in classrooms indicates mixed trends, as both absence and presence of gender differences have been reported (Klein, 2004; Morrell & Lederman, 1998). In early elementary years, girls appear to both enjoy and participate in science classrooms just as much, if not more than, their male counterparts (Pell & Jarvis, 2001). However, as they mature, a change begins and the attitudes of both genders seem to switch as girls participate less and boys participate more (Pell & Jarvis, 2001). Furthermore, Pell and Jarvis (2001) suggest “if the rejection of science by girls as they mature is to be reduced, it is important to build upon the positive start in primary years” (p. 855).

Assumptions

Based on my own teaching experience and published research-based literature in this area, I approached this study with several assumptions. My first assumption was that finding the
best gender groupings would maximize student participation thereby improve student attitudes
toward the study of science. A second assumption was that students would respond truthfully to the questions posed to them regarding their feelings on being grouped in alternating gender-based teams. A final assumption was that my point of view and thoughts on the students’ groupings did not interfere with examination of the data generated in the study.

Limitations

There were several limitations to this study. The first limitation to the study was the time frame the data were collected. Research was limited to one twelve-week period in the 2005-2006 school year. During the final month of the study, school was suspended for ten days in the aftermath of Hurricane Wilma. Another limitation to the study was the small convenience sample. The data for the study were gathered using one third grade class of nineteen students that had been assigned to me prior to the commencement of the school year. Furthermore, the sample of the students was homogenous and did not represent a wide range of ethnicities or socioeconomic backgrounds.

Terms

Attitude: “Learned predispositions, tendencies, or inclinations to respond fairly consistently in an unfavorable or favorable manner to a given object, namely, science”(Wareing, 1990, p. 372)

Constructivism: Constructivism is based on the theoretical framework of Bruner that learning is ongoing and must be student-centered with the teacher acting as facilitator of learning within the classroom community (Alkove & McCarthy, 1992). The constructivist pedagogy further believes, “learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge. The learner selects and transforms information, constructs
hypotheses, and makes decisions, relying on a cognitive structure to do so. Cognitive structure (i.e., schema, mental models) provides meaning and organization to experiences and allows the individual to "go beyond the information given" (Arts in Education, 2004).

**Cooperative Group:** Refers to the interactions of a group of students characterized by positive goal interdependence with individual accountability. A cooperative group has a sense of individual accountability that means that all students need to know the material for the group to be successful (Johnson, 1988).

**Discrepant event:** “A discrepant event puzzles the observer, causing him or her to wonder why the event occurred as it did. These situations leave the observer at a loss to explain what has taken place. Discrepant events influence equilibration and the self-regulatory process, according to the Piagetian theory of intellectual development. Situations that are contrary to what a person expects cause him or her to wonder what is taking place, resulting in cognitive disequilibrium. With proper guidance, the individual will attempt to figure out the discrepancy and search for a suitable explanation for the situation. When a person arrives at a plausible explanation for a discrepant event, he or she will establish cognitive equilibrium at a new level. The individual is now better equipped mentally to approach new situations that cause curiosity and puzzlement (Piaget, 1971)” (Koballa, n.d.).

**Gender:** Refers to sex-based male and female categories. Gender, rather than sex, is used in this work due to its accepted reference by anthropologists to social categories whereas sex has a more biological connotation (American History Dictionary, 2000).

**Inquiry:** Science inquiry is “the processes of doing investigations, developing the ability to ask scientific questions, investigating aspects of the surrounding world, and using observations to
construct reasonable explanations for the questions” (NRC, 1996, p. 122). Student led investigations of science phenomena allow students to develop significant understanding of the scientific principals they study at every grade level (NRC, 1996, p. 214).

**Participation:** Student participation is looked at in terms of discussions and involvement within group interactions. Participation in discussions refers to the quality, meaning the degree of depth of student interactions and type, meaning the kinds of sentences used to communicate, i.e., commands, questions, and direct statements. Participation in group interactions refers to type and frequency of active involvement while working with classmates on guided inquiry tasks.

**Science tools:** The science equipment third grade students manipulate to complete science inquiries. Tools include, but are not limited to, hand lens, pan balance, spring scale and meter stick.

**5E:** The 5E inquiry model, as conceived by Bybee, follows five stages: engage, explore, explain, extend, and evaluate. The engagement stage initiates the leaning task with students making connections between past and present learning and focusing students’ thinking on the current activity. The explore stage provides students with the opportunity to work on common scientific skills such as observation, data recording, hypothesizing, and organizing findings. The explain stage focuses student attention on particular theories of the engagement and exploration and allows teachers to introduce a concept or skill. Extension challenges students’ understanding with presenting new experiences. Finally, the evaluate stage allows students and teachers to assess student understanding of the topic (Bybee, 1997).
Summary

The primary focus of this study was to determine how student groupings affected third grade students’ participation and attitudes while completing science inquiries. The literature review, chapter two, looked deeper into the area of gender and its relation to students’ science attitudes and participation. The review began with a brief description of the background of educators’ interest in gender over the past decades. Major themes of the work followed: construction of knowledge, gender of science, students’ early experiences and attitudes, and students’ interactions. The review concluded with a call for further research in gender roles to improve students’ science experiences. Chapter three described the methods used to collect data for this study. Selection of participants, setting of the research, instruments used, and analysis of data were chronicled further in chapter three. Chapter four detailed my interpretation of the data and how that data related to each research question. Chapter five concluded the thesis and recommended further research involving student gender and student groupings.
CHAPTER TWO: LITERATURE REVIEW

Introduction

Researchers have spent decades studying the degrees to which students’ gender affects performance and attitude in science classrooms (Kahle & Lakes, 1983; Jones, Howe, & Rua, 1999; Pell & Jarvis, 2001; Patrick & Yoon, 2004). Interest in gender roles and how they affect students spans several continents. Research in this area has been conducted in Germany, Australia, Israel, the United Kingdom, and the United States (Haussler & Hoffman, 2002; Kahle, Parker, Rennie, & Riley, 1993; Klein, 2004; Pell & Jarvis, 2001, 2002). With numerous studies involving students in the elementary, middle, and secondary schools across three continents, the one resounding finding is results on gender roles in the classroom are not conclusive. Data on the degree to which gender affects students’ attitudes and performance in science is inconclusive (Klein, 2004).

Most data collection regarding gender issues and the study of science focus on middle, secondary, and post-secondary students and rarely has the focus been on upper elementary students (Haussler & Hoffman, 2002; Kahle et al., 1993; Klein, 2004; Morrell & Lederman, 1998). Even less research has been conducted on early elementary students and their attitudes and participation during their introductions to the field of science (Jarvis & Pell, 2002). Despite the accumulated collection of science and gender data generated by the research, little progress has been made in helping students form more positive attitudes toward science (Morrell & Lederman, 1998).

Differences between boys and girls academic achievement and attitudes have been attributed to biological causes, such as the hard wiring of the brain, as well as cultural and social
stereotypes (Klein, 2004). Despite ambiguous findings, the need to continue to research students’ science experiences, particularly at a young age, is pivotal to becoming cognizant of the most effective ways to positively engage them in science. Couched within a theoretical framework of how knowledge is constructed, several themes were examined from a review of the literature: the gender of science, students’ early childhood experiences, science attitude, interactions with peers, specifically focusing on participation in discussions and cooperative groups, and use of tools. These themes contributed to an understanding of students’ feelings about science, which may affect their participation and attitudes in the study of science (Pell & Jarvis, 2001; Patrick & Yoon, 2004; Tindall & Hamil, 2004).

**Constructing Scientific Knowledge**

The National Research Council advocates inquiry generated from personal experience is key in students’ ability to develop scientific knowledge (1996). Science inquiries promote children’s discovery of concepts in ways that make sense to each child. This knowledge is then socially constructed via discussions and debates with classmates (Johnston, Dunne, & Mairead, 1996). Discussions with classmates empower students to take ownership of their learning, an essential piece of building knowledge (Osborne & Collins, 2001). Student to student communication plays a critical role as students strive to construct meaning about their world (Atwater, 1996).

Vygotsky asserted communication is essential for student learning to occur as he conceived the Zone of Proximal Development. Vygotsky believed students have the ability to understand some concepts independently, however comprehension is greatly increased when communication with others occur. That is, students’ independent ability to develop ideas and the
potential level of development he/she has when communicating with others suggests
communication is critical in the development of understanding (Vygotsky, 1978). Furthermore,
Vygotsky’s theory suggests the necessity of guiding students, via social communication, to
facilitate successful knowledge development.

Inquiry classrooms strive to create atmospheres that foster student questioning,
discussions, and understanding (NRC, 1996). That is not to say inquiry relies solely on
discussion or demonstrations, rather successful inquiry-based instruction focuses on
incorporating real world experiences and authentic situations to develop a rich understanding of
science concepts (Lee & Songer, 2003). It is important to realize, science is not about mundane
science activities, which do nothing to enhance the students’ learning (Dewey, 1910).
“Traditional practices in science classrooms such as lectures, demonstrations, and cookbook lab
experiments rarely support a culture of inquiry and often instead promote the culture of
schooling” (Lee & Songer, 2003, p. 926). Dewey asserts, “Only by talking a hand in the making
of knowledge, by transferring guess and opinion into belief authorized by inquiry, does one ever
get a knowledge of the method of knowing” (1910, p. 124). The successful combination of
socially relevant and constructivist based science lead the way to continuous science learning to
a wide range of identities (Hughes, 2001).

Piaget, a forefather of constructivism, illustrated the importance of ongoing learning,
“Scientific knowledge is in perpetual evolution; it finds itself changed from one day to the
next”(1968). By combining the socially constructed nature of science with ongoing constructivist
learning theories students’ learning is maximized when inquiries are used in the classroom
(Hughes, 2001). Scientific inquiries combine in-depth science concept understanding and
rigorous application of scientific thinking processes to promote student learning (Lee & Songer, 2003). Inquiry based classrooms build students’ scientific knowledge by linking new science experiences with prior experiences (Kelly, 1999).

Gender of Science

Researchers have embarked on a quest to learn the degree to which gender and the study of science are related. When ranked on degrees of masculinity and femininity, scientists tend to have a strong work ethic, a well developed sense of order, and be authoritarian. All of these characteristics are considered masculine qualities (Gilbert & Calvert, 2003). Keeves and Kotte (1996) suggest girls who perceive science as a male domain of activity are less likely to participate in the field. As work in science and gender progress, those who exhibit more of these masculine qualities are more apt to become involved in the study of science because of its reputation as being “dispassionate, detached, and masculine” (Gilbert & Calvert 2003, p. 862).

These masculine traits are often illustrated in children’s media such as literature, television, and Internet with the scientist personified as a pudgy, middle-aged, white male. Students see this image of scientists and try to relate it to their own self-image (Keeves & Kotte, 1996). Relating to the perceived image of whom a scientist is becomes problematic when, because of dissimilar characteristics, students tend to classify themselves as someone ‘not like that’ and the beginnings of science attitudes and perceptions are formed. According to the Kaiser Family Foundation 2005 study, children between the ages of 8 and 18 spend an average of six hours a day interacting with various forms of media. Although the extent of stereotypical influences from media is unknown, “indications are that negative stereotypical images translate into negative perceptions of science” (Finson & Beaver, 1995, p. 196). Thus, these images may
continue to solidify the masculinity of science as the stereotypes of scientists continue to
inundate the media. Additional research into the stereotypes and gender images associated with
the exposure to media may indicate the importance the images have in students’ perceptions of
masculinity and femininity and the roles of each (Steinke, 2005).

Science is considered masculine, competitive, objective and impersonal; these qualities
alienate girls from science (Brickhouse, Lowery, & Schultz, 2000). Kelly argues that the
masculinity of science may be broken down into four issues:

First, the sheer amount of men visible in science fields project science as
masculine. Second, science education revolves around interest of boys. Third, the
gender roles students act out in class and the responses from teachers, positive for
boys, negative for girls, display science as masculine. Finally, the connotation that
science is male dominated may discourage girls from studying it (1996, p.7).

Kahle and Lakes suggest the gender of science has been evident for decades by the values
schools seemingly place on students (1983). The values often associated with boys mirror the
masculine characteristics previously mentioned and include independent, logical thinking, self-
confidence, and risk taking. The characteristics of girls valued in schools seem to be the opposite
of masculine science images by placing worth on emotional expressiveness, sensitivity,
dependency, and subjective thinking (Kahle & Lakes, 1983). If science is perceived by students
to be related to masculine characteristics, they may not identify their personal characteristics as
similar and may shy away from actively participating in science tasks. “Science cannot be
accessible to a wide spectrum of learners if it is conceived of as unitary” (Lederman, 2003, p.
604). If students perceive science to be unitary and disengage from science learning because of gender-stereotyped images, it is not equally accessible to all learners.

It is noteworthy to mention, the association between science and gender must not be oversimplified. Within the field of science, specific branches of science have gender connotations. Physical science is considered masculine, but biological sciences are considered more “gender-ambiguous” (Hughes, 2001, p. 276). Masculine subjects do not universally encourage boys nor are all girls universally deterred by masculine subjects (Hughes, 2001). However, the connotation of science as masculine may discourage some girls from participating in science because they fear they may be perceived by others as less feminine than their peers not interested in science (Breakwell, Vignoles, & Robertson, 2003).

Recent work exploring the dimensions of masculinity and femininity within science may be somewhat faulted when researchers collect data in a climate where gender stereotyping is conscientiously avoided. Students may offer responses they believe to be socially acceptable rather than as they truly feel (Breakwell, Vignoles, & Robertson, 2003). The crux of gathering unbiased data continues to challenge researchers intent on gathering data regarding the gender of science. “As science’s image becomes more accurate, the number of girls participating and achieving in science will increase, and science classes will transform, not reproduce, society’s stereotypic version of science” (Kahle, 1996 p. 136). Until more positive images and perceptions of feminism and science exist, support and nurturance to all students during the early years of education is essential.
Early Childhood Experiences

During elementary school years boys and girls are equally likely to say they are going to be scientists when they grow up (Shakeshaft, 1995). However, despite the assertion by Pell and Jarvis (2002), that science experiences in early childhood influence students’ academic interests and achievements, little is known about how to keep and increase that early childhood motivation. The National Research Council states it is necessary that all students, in every grade, have the opportunity to use science inquiry to develop their ability to think (1996). Dewey argued the importance of cementing young students’ beliefs in science “attitude toward the study of science is, and should be, fixed during the early years in life” (1910, p.123). Later research by Woodard and Woodard concur that, girls’ interest in science is “clearly delineated by the end of primary schooling…suggesting intervention strategies need to be targeted at the primary level” (1998, p. 398).

The difficulty with targeting students’ gender roles, even in their primary years of education, lies in the fact the children have been exposed to gender roles since birth. Boys play with trucks and engage in rough and tumble games, whereas girls read and play quietly. By the time children begin formal education, they are “considerably experienced in gender-appropriate activities” (Harding, 1996, p. 4). These gender-appropriate activities not only affect students’ choices in science study as they progress through school, they also affect the students’ attitudes toward science (Harding, 1996). Once students begin formal schooling it is essential they have frequent and positive exposure to science because the early childhood experience will be the foundation for developing attitudes toward science (Jarvis & Pell, 2002).
Students’ Science Attitudes

Students’ attitudes toward science, particularly in the early elementary years, must be closely monitored because they may influence the students’ accomplishments, and more importantly, their later views of science education (Jarvis & Pell, 2002). Young elementary school students have a positive attitude toward studying science, but see it as difficult. As students progress in school their positive attitudes diminish while their perceived ease of science increase (Pell & Jarvis, 2001, 2002; Morrell & Lederman, 1998). Despite the continued and abundant research in the area of students’ attitudes toward science, “neither has the extent or direction of a relationship between attitude and achievement in science been clearly established in cases where the evidence of some influence has been found” (Wareing, 1990, p. 372).

Student attitudes may be broken into five key classifications: “beneficial aspects of science; interest in learning science; ease of learning science; career interest in science; and school and school learning” (Keeves & Kotte, 1996, p. 81). Beneficial aspects of science involve how worthwhile students believe the study of science to be. Interest in learning science indicates the degree to which students report wanting to learn more science. Ease of learning stipulates the skill levels students’ perceive they need to study science. Career interest in science relates the connection between students’ self and science perceptions as they think of their future aspirations. Finally, school and school learning expresses the involvement of the general science experiences of school children (Keeves & Kotte, 1996).

Research has been conducted on many classifications of science attitudes and results, at best, are inconclusive. Keeves-Kotte (1996), Jarvis (1996) and Osborne-Collins (2001) concur in their research that both boys and girls think science is important to study, especially in terms
of the medical field, thus have a positive attitude of the beneficial aspects of science. Osborne and Collins’ 2001 study involving students in the United Kingdom found students believed science was a worthwhile career in the fields of veterinary medicine or piloting aircraft; however, it was not a universal requirement for all careers, such as music, banking or hairdressing (p. 447). A 1990 poll commissioned by the American Association of University Women (AAUW) found both boys and girls had the greatest enthusiasm for the study of science in the elementary years. As students progress in school, that enthusiasm dropped, but loss of enthusiasm was greater for girls than boys (AAUW, 1996). Pell and Jarvis conducted a two-year longitudinal study that led them to confirm the AAUW previous report, both boys and girls have positive attitude in both interest in and learning of science in the primary years, but those attitudes shift as children approach adolescents (2002). The shift in students’ attitudes has been attributed to lack of use of tools, perceived difficulty of science, relevance to students’ lives and general involvement in active participation in science tasks (Jones & Wheatly, 1989; Pell & Jarvis, 1996; 2002; Osborne & Collins, 2001).

Science attitudes are based on science experiences and are formed as boys and girls begin the study of science (Tindall & Hamil, 2004, p. 288). “In grades K-3 classrooms, an average of only 17 minutes per day is spent on science” (Kahle & Lakes, 1983, p. 138). Lack of science experience leads to lack of understanding which leads to negative attitudes toward science (Kahle & Lakes, 1983). Negative science attitudes can also develop as young students are grouped with classmates. In both single and mixed gender groups, boys are more involved with equipment while girls watch. The lack of participation can lead to frustration and negative science attitudes (Jones & Wheatly, 1989).
Gender Based Student Interactions

Boys and girls do not experience science skills and activities equally (Kahle & Lakes, 1983). “Boys have more confidence in their ability to do science than do girls. Girls are more likely to see themselves as science outsiders, rather than science insiders” (Shakeshaft, 1995, p. 75). One having little confidence in his/her science abilities is a science outsider, whereas a science insider has confidence in his/her science abilities (Shakeshaft, 1995).

While grouped in same gender groups, students have different interactions with the teacher. “Teachers tend to initiate teacher-student interactions with all boy groups, while students tended to be initiators of interactions with all girl groups” (Rennie, Parker, & Kahle, 1996, p.207). Girls often tend to lack the confidence to proceed independently on science tasks without teacher assistance (Rennie et al., 1996). Teachers have a responsibility to “present science as equally appropriate for girls and boys, to expect girls to use the tools of science with facility, and to expect both boys and girls to engage thoughtfully in science activities” (Jones, Howe, & Rua, 1999, p. 190). Without appropriate teacher interactions, students cannot equally participate in school science.

Thorne (1994) states, boys’ and girls’ social interactions differ greatly (p.89). Boys tend to be overtly competitive and hierarchical- negotiating and ranking themselves through insults, direct commands, challenges, and threat. Girls tend to maintain intimacy, share, and monitor each other’s emotions (p.92). Boys acting competitively assert control over materials in ways that could be damaging to their partners, whereas girls focus on building relationships during the learning process both with each other and the materials they use (Jones, Brader-Araje, Carboni, Carter, Rua, Banilowere, & Hatch, 2000). Consequently, the work of Jones et al., (2000)
suggests girls’ performance in science inquiry classrooms may be higher than boys’ performance simply because the girls are focused on the task and materials at hand, rather than competing with each other, as boys do. “Differences between boys and girls are natural. Those differences should be acknowledged, accepted, and exploited for educational purposes” (Sax, 2005, p. 63). By acknowledging and seeking to understand the differences related to student gender educational experiences for girls and boys may improve.

Gender and Participation in Classroom Discussions & Cooperative Groups

Cooperative groups enable students to articulate their thoughts and ideas on science and ultimately increase their scientific knowledge because of the interactions with peers (Jarvis, 1996). However, girls and boys interact differently in cooperative groups and it is essential the interactions be monitored to facilitate the necessary student discussions that develop scientific knowledge. Science confidence, or lack there of, is notable in the manner and frequency students actively participate while grouped cooperatively (Mewborn, 1999). In groups, girls tend to volunteer for secretarial tasks, which exclude them from fully participating in the science task at hand (Mewborn, 1999). The lack of confidence on the part of female students may manifest in ways beyond sitting on the side and letting the boys complete the science activities while the girls watch. Girls may not even volunteer to answer questions posed by the teacher or classmates, which can lead to a monopolization of discussion by only a few students (Tindall & Hamil, 2004). Student lack of participation in classroom dialog should be monitored to ensure students are equally involved in classroom activities. Balanced interactions of both boys and girls in the science classroom enable students to equally participate in science discussions.
“Students need opportunities to present their abilities and understanding and to use the knowledge and language of science to communicate scientific explanations and ideas. Writing, labeling drawings, completing concept maps, developing spreadsheets, and designing computer graphics should be a part of the science education” (National Research Council, p. 144).

Collaboration with peers improves scientific understanding (NRC, 1996). Students differ in both their personal academic ability levels and their personal comfort levels; therefore, a wide variety of participatory events must be used in the science classroom. “There is wide variation in patterns like readiness to talk in class, and classrooms vary in patterns of teacher-student interaction” (Thorne, 1994, p. 160). A key aspect of elementary science classroom inquiries is student cooperation within cooperative group discussions. “For students to gain the most substance from investigations, they need to discuss expectations, observations, conclusions, theories and explanations before, during and after conducting the activity” (Patrick & Yoon, 2004, p.320).

Boys participate more and are more active in class than their female classmates in group discussions and beyond (Shakeshaft, 1995; Klein, 2004). Boys demand teacher’s attention more than girls, who are perceived by teachers to be better behaved in class (Klein, 2004). Often boys demand more attention by volunteering ideas and thoughts more frequently than girls so teacher interactions with boys are more frequent (Sadker & Sadker, 1995). Furthermore, teachers are more tolerant of call-outs from boys than from girls, who are often told to “wait their turn and be polite” (Shakeshaft, 1995, p. 77). Call-outs in class from boys occur eight times more frequently
than from girls and teachers are more likely to listen and respond to the call outs from boys, while girls that call out are corrected about behavior with reminders of rules. (AAUW, 1996)

“Power is central to the social relations of gender” (Thorne, 1994, p. 159) In classrooms, boys control more space and often violate girls’ activities. (Thorne, 1994). The controlling of space, as Patrick and Yoon, (2004) suggest, illustrates boys are more dominate in small group activities than girls. Kahle and Lakes (1983) agree that when paired in mixed gender groups, boys frequently do the work, while girls watch. Boys also volunteer more than girls and consequently are selected more frequently to participate in demonstrations (Kahle & Lakes, 1983).

Despite the difficulties arising from cooperative groupings, students like the cooperative, hands-on, aspects of science where they choose the equipment to use and find answers to their questions (Jarvis & Pell, 2002). The gender differences become apparent when a closer look at students’ interaction during cooperative groups is examined. Boys like to independently find out why experiments work and like to select their own science equipment. In contrast, girls prefer to work closely with teacher guidance (Jarvis & Pell, 2002). When girls are not encouraged to independently take apart items to see how they work, they are losing opportunity to develop their scientific thinking skills (Kahle & Lakes, 1983). To maximize group participation these differences must be accounted for when grouping students cooperatively.

The AAUW found a majority of students prefer single-gender cooperative groups when working with classmates. Different communication patterns between males and females can be obstacles to effective dialog and may be one reason students prefer same gender groupings (AAUW, 1996). When speaking, females frequently use indirect speech and rely on questions.
Males favor direct speech involving declarative sentences (AAUW, 1996). If the manner in which students communicate affects their involvement in and learning from science inquiry, modifications must be made so all students benefit from the inquiry equally. Like the AAUW, Thorne, (1994) suggests whenever possible, students should be organized into small heterogonous and cooperative work groups to allow students to focus on a common goal, rather than ‘them vs. us’ attitude. Active participation in science inquiries and discussions is critical to developing scientific based process skills that will allow students to continuously participate in science lessons. “In student-student interactions, meaningful conversation is important if learning is going to take place in student groups” (Atwater, 1996). Finding the most compatible gender grouping to facilitate the inquiry process may be one way to increase students’ participation and attitudes in elementary science class.

**Use of Tools**

One of the most effective ways to interest young students in the field of science is to lead them in hands on inquiry-based experiences (NRC, 1996). “Science inquiry, unlike many other fields of study, is integrally bound to the use of materials and equipment” (Jones et al., 2000, p.760). One drawback to implementing inquiry-based experiences may be the multiple supplies needed to complete activities. Inquiry based science revolves around the successful use of tools and students’ comfort level with those tools affects their ability to perform inquiries (Jones et al., 2000).

Students enter school with varying degrees of familiarity with science tools. (Shakeshaft, 1995). Boys and girls both must manipulate tools properly to perform the inquiry at hand. As young learners, the primary development of tool expertise is through playing and tinkering
Jones et al., further indicates boys do over five times as much random playing and nearly three times as much purposeful tinkering than their girl counterparts (2000). Beginning as early as Kindergarten, “boys have greater access and opportunities to manipulate science materials” (Kahle et al., 1993, p. 383). Girls tended to touch tools only when told to by the teacher (Jones, Howe, & Rua, 1999). As students grow older this childhood tinkering leads to dominating supplies in science classrooms.

Boys typically dominate science tools because of a perceived expertise with the equipment since, as small children, boys have had more experience with the manipulation of various tools (Carter, Westbrook, & Thompkins, 1999). “Boys are more familiar with concepts in the physical sciences and are more likely to have worked with the tools and materials commonly found in science labs than are girls” (Shakeshaft, 1995, p. 75). With the increased experience of tool manipulation, boys may try to impress their classmates with their expertise and dominate the science tools (Kahle et al., 1993, p. 377). Girls also have experience with tool manipulation, but the tools, such as measuring cups and garden tools are not considered ‘scientific’ by all students (Shakeshaft, 1995). The American Association of University Women, state, “by grade 3, 51% of boys but only 37% of girls have used microscopes” (1992, p. 45). The gender differences that affect students’ science participation begin at an early age and continue throughout school. With such varied tool manipulation experience it may be suggested that it is beneficial for all students to have equal and frequent opportunity to work with a variety of scientific tools to enable all students to successfully utilize tools during science inquiries. Tool manipulation and social interactions lead students to develop a more complete understanding of science (Kelly, 1999).
Summary

Teachers using scientific inquiry strive to facilitate students’ understanding of science topics through questions and investigations. Inquiry approaches exhibit how scientific knowledge is constructed (Lee & Songer, 2003). As educators we must strive to create the optimal environment for students to build science experiences.

Teachers must be aware of gender issues and how they affect each student, particularly in class discussions, roles within cooperative groups, and students’ use of tools. Just because a subject, such as science, is perceived easy or difficult by the student, does not correspond to the student’s performance in that subject; performance, rather, is based on equal opportunities (Jones et al., 2000). “There is no difference in what boys and girls can learn. But there are big differences in the best way to teach them” (Sax, 2005, p.106). Intentionally creating equal opportunity for boys and girls to participate may help students develop strong science understanding.

With further research into the areas of gender and equitable education teachers will optimize science time in the classroom so students gain deeper understanding of science through inquiry methods equally beneficial to all. In this work, student gender issues were looked at in five main contexts: construction of knowledge, gender of science, early childhood experiences, students’ science attitudes, and gender-based interactions. For students to have an equitable science education, it was important to note the experiences students have in science classrooms influenced their attitudes toward science education (Lederman, 2003). The design of this study is presented in chapter three. Classroom environment and student population are also detailed and
explanations of instruments are provided. The methodology of the study, including data collection methods and data analysis, is explained.
CHAPTER 3: METHODOLOGY

Introduction

The purpose of this study was to examine my teaching practices involving third grade students’ attitudes and participation during science instruction as students were alternately grouped in same and mixed gender teams. Qualitative methods were used to obtain data in this study. The data were collected using multiple sources: teacher-researcher created attitude surveys, student focus groups, student journals, and teacher-researcher field notes and observations. Pre and post surveys including the Draw A Scientist and Student Science Survey by Pierce (1999) were also used to collect data on students’ feelings and attitudes while grouped in alternating same and mixed gender teams during science class. This chapter chronicled the design, setting, instruments, data collection and analysis of the study.

Design of Study

The aims of this action research study focused on the affects gender had on students’ participation in and attitudes toward the study of elementary school science. Action research was chosen as the design for this study. Action research, as defined by Mills (2003), is the “systematic inquiry conducted with the goals of gaining insight, developing reflective practice, effecting positive changes in the school environment, and improving student outcomes” (p. 5). As the research questions indicate, the I sought data to affirm which student groupings enabled students the most opportunity to participate fully and equally in inquiry-based science lessons. Primary data were generated with students thoughts and ideas shared through surveys, focus groups, journals, and interactions with the teacher.
Qualitative data collections were necessary to capture the thoughts of the students as they worked in both same and mixed gender groups. Qualitative research focused on the importance of looking at variables in the natural setting, direct data collection, and inductive data analysis; thus it was selected to be the main design of the study (Patten, 2000). The qualitative approach enabled me to collect rich, narrative data that illustrated students’ feelings, reactions and attitudes in various classroom science activities. It further enabled me to study underling behavior patterns and the resulting outcomes of student interactions. By observing and interacting regularly with participants I was able to collect detailed, verbal descriptions of behaviors and interactions in the classroom setting.

To increase credibility and trustworthiness, data were gathered and triangulated from multiple sources: surveys, student focus groups, student journals, and teacher-researcher observation notes. Triangulation of data involved the convergence of data from multiple collection sources (Patten, 2000). Findings were compared to verify consistency and to uncover common themes. By collecting data from a variety of sources, themes and patterns emerged related to students’ participation and attitudes towards science.

**School Setting**

This K-5 elementary school population consisted of 1,014 students. As reported by the Broward County Schools website, Diversity Characteristics by School, of those 1,014 students, 799 (78.6%), were Caucasian; 105, (10.3%) were Hispanic; 54, (5.3%) were Asian; 33, (3.2%) were African American; 7, (0.7%) were Native American; and 18, (1.8%) are multiracial. 502 students, (49.4%) were girls and 514 were boys, (50.6%). The school is located in an upper middle class socioeconomic community. Forty-six students, (4.6%) of the 1,014 total enrollment
received free or reduced lunch. Of the 1,014 population 16, (1.6%) were enrolled in the Limited English Proficiency program. The school’s Exceptional Student Education programs enrolled 104 students, (10.2%).

**Classroom Setting**

In this third grade class, data were collected from nineteen students, 10 boys and 9 girls. The class consisted of 15 Caucasian students, 3 Hispanic students, and 1 Asian student. Of the nineteen participants 1 received free/reduced lunch. One participant moved from Bolivia at the beginning of the school year and initially spoke no English but was able to make drastic language acquisition advances during the course of the study. Two of the nineteen students read at a Pre-Primer level and 4 read at a Primer level. Of the remaining 13 students 6 were given additional reading assistance because they were reading below grade level.

Several accommodations were made for the student from Bolivia. The student was able to take home pre and post-study attitude surveys to make certain he understood the questions and responded accurately by asking his mother to help him translate. In the science journal the student was allowed to respond to questions by writing free responses in either English or Spanish. When necessary, I asked a colleague to translate any undecipherable phrases.

**Instruments**

The purpose of this study was to assess students’ participation and attitudes while grouped in same and mixed-gender teams in science class. Instruments in this action research study were selected and constructed based on the degree to which each instrument would assist in gathering information to answer each research question. Instruments included the Draw A Scientist Test, Science Attitude Survey, teacher-researcher created attitude surveys, student focus
groups, student journals, field notes and observations. To ensure accuracy in teacher-researcher generated attitude surveys, a pre-study pilot was conducted to assess the layout and format of the survey. Questions proved unreliable were removed from the survey.

Instruments and surveys examining gender and its affect on students abound in science literature, however most instruments are aimed at middle school students and beyond (Breakwell, Vignoles, & Robertson, 2003; Gilbert, 2003; Brickhouse, Lowery & Schultz, 2000; Woodard & Woodard, 1998). To accurately capture the third grade students’ attitudes, feelings, and participation regarding their science groupings, I generated several surveys worded for young elementary students.

Surveys were aligned with research questions and piloted to check the wording and formatting. First, four colleagues proofread the surveys for age appropriate readability. A fellow third grade teacher granted permission to present each survey to student volunteers in her third grade class. As students completed the surveys, I documented any difficulties they had in comprehending the questions or frustrations due to wording of the questions. Student volunteers were asked which questions were confusing or too difficult to understand. Colleagues were also asked for ideas and feedback that would make the surveys more student-friendly. Upon receipt of the colleagues’ and students’ feedback, I modified the surveys before presenting them to the participants. Original piloted surveys were destroyed. The following sections describe how each instrument was utilized to gather data on the research questions.

**Draw A Scientist Test**

**Draw A Scientist Test (DAST)**, originally created by Chambers in 1983, created a free form student response to a teacher directed prompt of ‘Draw a scientist’. The DAST was selected
because all children were not able to fully express themselves effectively in words and the DAST allowed children to draw a representation of their perception of a scientist that they were unable to express. Schibeci and Sorenson found the Draw A Scientist Test a reliable method for assessing global images of scientists (Sumrall, 1995).

**Pre and Post Science Attitude Survey**

The *Science Attitude Survey* (Appendix E), published in Pierce’s text, *Nurturing Inquiry* was selected to generate data on students’ attitudes on a range of science and learning statements throughout the study. The survey consisted of 20 Likert-type questions and 1 open-ended question, however, only questions directly related to attitude and participation were analyzed. The questions analyzed were: 5, 6, 10, 12, 13, and 21.

**Pre and Post Teacher-Researcher Generated Surveys**

The *Student Attitude Survey* (Appendix F) was created to ascertain students’ thoughts on their roles in cooperative science groups. This survey was selected to illicit responses to topics such as gender, use of tools, and student groupings and was a measure of students’ attitudes. The *Student Attitude Survey* contained 10 teacher-researcher created questions soliciting yes/no student responses.

The *How Do You Feel About Science Experiments* (Appendix G) survey measured students’ perception of their involvement with and enjoyment of science experiments. These third grade students had difficulty distinguishing the degree of difference between terms that would normal be seen on a Likert-survey such as ‘agree’ and ‘strongly agree’. To ensure the students accurately described their feeling about each question I replaced the traditional agree/disagree Likert scale with ‘smiley faces’ modeled after Jarvis and Pell’s 2002 study. In this
10-question survey, students circled one of five ‘smiley faces’ to correspond to the degree to which they agreed or disagreed with each question.

The faces, although each was the same size, had different expression. To correspond with strongly agree, the ‘smiley face’ had a huge grin. To correspond with agree, the face had a pleasant smile. For disagree the expression was a frown. The expression for strongly disagree was a big frown with arched eyebrows showing a very unhappy expression. Additionally, there was a solemn face with the mouth drawn in a straight line to indicate no opinion. A final smiley face was attached to arms shrugging, indicating ‘I don’t know’. Because these students had never before been formally introduced to science in the classroom it was important they had an option to express their true feelings rather than circle a face because there was no other choice.

The *Weekly Group Feedback* (Appendix H) measured students’ participation and attitude in same and mixed gender groupings. The survey consisted of 10 questions: 2 multiple choice, 1 ‘smiley face’ Likert-type, 1 open-ended response, and 6 yes/no responses focused on students’ responses about their participation with the assigned gender group.

The final teacher-researcher made survey, *How Do You Feel About Science?* (Appendix I), focused on enjoyment and involvement with science activities at home and at school and was an additional measure of students’ participation in and attitudes toward science. The survey consisted of 9 ‘smiley face’ Likert-type questions. The use of surveys throughout the study facilitated a large amount of data being collected in a relatively short period (Mills, 2005).
Student Focus Groups

Students were randomly selected, by drawing names from a box, to participate in focus groups. The purpose of the groups was to allow students the opportunity to speak candidly about their group experiences while generating data on topics such as:

How well did you work with this group?

What did you enjoy most or least about working with this group?

If you could change anything about this group what would it be?

The focus groups were centered on a reflective point of view; students were not permitted to ‘gang up’ on or speak rudely about classmates per the classroom norms. If a comment needed to be voiced, students were instructed to use an anonymous phrase like, “Someone in my group…” or “I did not like when someone in my group…” Osborne and Collins recommend the use of focus groups to “offer a means of exploring the principal issues of interest in a dynamic manner which utilizes the group interaction to challenge, and probe, the views and positions espoused by individual members in a non-threatening, relatively naturalized social context” (2001, p. 443). Mills (2003) advocated the importance of conducting focus groups to gather participants’ thoughts of a particular area.

Student Journals

Student journals were written responses to teacher-posed questions after each science inquiry. In addition to reflecting on the inquiry and answering content area questions, students were asked to reflect on their involvement within and attitude toward the particular group with which they had worked. The entry uniformly listed the date, the name of the inquiry, and if the group was same or mixed gender. Students were encouraged to write freely any thoughts or
feelings they experienced during the group inquiry. These journals provided a “window into the students’ world” (Mills, 2003, p.67) that provided details from the students’ point of view about the day’s inquiry as it related to the research questions.
Field Notes and Observations

Field notes and direct observations were recorded to capture interactions between students and teacher over the course of the study. Teacher involvement with each group, unusual circumstances that may have influenced students’ participation, and excerpts of students’ dialogs were recorded for later study.

Methodology

The following account detailed the procedures for collecting data for this study.

Data Collection

In May of 2005, an Internal Review Board (IRB) Committee form (Appendix A) was submitted and approved by the Office of Research of the University of Central Florida. After receiving University approval, principal consent was requested and granted (Appendix B). Following that, parental information and consent letters (Appendix C) were sent to the families of the nineteen students in this class to introduce the action research project. After receiving parental consent, I read the Child Assent Script (Appendix D) to the students to ensure they understood they were not obligated to participate in the study. Upon student consent, the data collection began with the pre-assessments. All students were given pseudonyms to protect privacy. All student surveys were completed anonymously with only a notation of student gender. Surveys, journals, and field notes were stored in a locked file cabinet to which only I had access.

Students completed two science units during the course of this study, Properties of Matter and Simple Machines. Students first began studying Properties of Matter by completing three 5E guided inquiries including Apple of My Eye, Measuring Mass, and Does it Add Up?. As students
progressed to the Simple Machines unit they completed four 5E guided inquiries including *Are You So Inclined, Clever Lever, Lifting with Levers*, and *On a Roll*.

**Draw A Scientist Test**

The Draw A Scientist Test was used to collect pre and post data about students’ perceptions of science and gender. The DAST was administered first in week one of the study and again in week twelve.

**Pre and Post Science Attitude Surveys**

To gather data on students’ science attitudes, participants completed two science attitude surveys during the study. In weeks one and twelve of the study, students completed the teacher-researcher created *Student Attitude Survey*. This survey generated data on ten different science attitude questions requiring a yes/no response that later would be used in triangulating data with other sources from the entire study.

Students also completed the *Science Attitude Survey* Pierce published in his 1999 text in weeks one and twelve. Although the survey is 21 questions in length, this study focused primarily on six questions that concentrated on students’ attitudes and group participation perceptions.

Each survey was read aloud to students in both pre and post administrations to ensure students responded accurately and were not hindered by reading comprehension difficulties.

**Pre and Post Teacher-Researcher Generated Surveys**

To collect data reflective of the students’ attitudes, before, during, and after the data collection period students completed a variety of teacher-researcher generated surveys. Initially, students completed the *How Do You Feel About Science, How Do You Feel About Science*
Experiments, and Student Attitude Survey in week one of the study. The Weekly Group Feedback survey was administered after the completion of each science inquiry, a total of seven times. The students initially completed questions independently as I read the questions aloud. As time progressed and students became familiar with the procedure they were able to complete the survey independently.

Student Focus Groups

Based on a random sampling of students, periodically throughout the study students were asked to dialog with me about the group experience to supplement information generated in the science journal. At the beginning of the study the intention was to meet with all students at least once a week in focus groups to gather vast amounts of data. As the year progressed and schedules were interrupted by the usual and unusual events of an elementary school, the focus group meetings decreased. By the end of the study focus groups occurred only sporadically.

Student Journals

Students generated data regularly throughout the course of the study in their science journals. At the completion of each science inquiry students were asked to complete an entry in their science journal. Initially, the students were given prompts created to determine attitudes and levels of participation while working in teacher assigned groups. As the study progressed students were encouraged to expand their thoughts and accompanying reasons. Students were also encouraged to freely report anything they felt was of value I should understand from their point of view about the inquiry.
Field Notes and Observations

Using direct observations I recorded the time, date and relevant tones of each inquiry. Tones included the students’ level of enthusiasm before, during and after the inquiry; the attitude students approached their teacher assigned groups, and parent volunteers present.

During the study I monitored students’ participation in the science inquiries and recorded findings in field notes. Field notes recorded teaching practices, observations, the degree to which assigned tasks were completed, and general student behavior. I noted excerpts of group discussions, student roles within groups, frequency and type of student-student interactions as well as student-teacher interactions. Any unusual occurrences, such as fire drills, were recorded. Parent volunteers present were also noted along with the role the volunteer played.

Data Analysis

Data generated in this study were examined looking for emerging themes related to students’ participation in science inquiries, their attitudes toward the general concept of science, and their attitudes while participating in gender–based groups. Data from a variety of sources were triangulated to ensure trustworthiness of findings. By charting findings from pre and post surveys as well as the students’ attitudes, both observed and stated in written responses, I was able to ensure credibility in findings. The following details each of the instruments and a brief description of the analysis of that instrument.

Draw A Scientist Test

Both pre and post Draw A Scientist Tests were compared to note any changes in whom students perceive to be scientists. Specifically, the gender of the scientist, the tools present in the drawings, and the setting of the drawing were analyzed. These third grade students had not
received a great deal of formal science instruction in their early years of school so this initial data provided an intriguing look into the concepts students formed from media exposure and personal experiences.

**Teacher-Researcher Generated Surveys**

All survey results were charted to compile a collection of data on students’ attitudes before, during, and after the study. Data from surveys were identified by student gender and sorted according to the research questions the findings supported. The surveys were collected and analyzed the day they were conducted so I could triangulate data generated from surveys with field notes and students’ journal entries. Data were examined to find patterns indicating students’ attitudes and participation while in gender based science groups.

**Student Focus Groups**

I hand recorded student-student and teacher-student dialogs during focus groups. Data were studied in comparison to the individual student’s journal responses and attitude surveys. Data were also compared with my direct observation of students during the inquiry. Student focus groups began with the first inquiry, however due to time restraints, the frequency of the groups decreased to several times during the month, focusing on particularly detailed inquiries.

**Student Journals**

Students’ journals were collected after each inquiry and students’ responses were logged into a chart that was later compared with the *Weekly Feedback Survey*, teacher-researcher observations, and when appropriate, the student focus group notes. The chart was used to look for emerging patterns of students’ attitudes and participation.
Field Notes and Observations

Field notes were analyzed in comparison with students’ journals, Weekly Feedback Forms and focus groups. Using the field notes in conjunction with previously recorded data allowed for a complete and detailed review of the tasks performed and the degree of participation and subsequent attitudes resulting from the inquiry.

Summary

By examining student surveys, journals, focus groups, teacher observations and notes I examined the data to discover patterns emerging on how students’ participation, attitude and learning in the science classrooms were optimized. The purpose of the study was to analyze my teaching while examining the roles of gender in the elementary school, specifically regarding students’ roles within same and mixed gender groups. The goal of the study was to improve students’ science learning by determining which student groupings provide the most opportunity for active and equal participation in science inquiries and in turn promoted positive attitudes toward science.

Chapter three presented the design of this study. The school setting and the methodology were outlined. Descriptions of instruments used were provided along with data collection measures and analysis. Detailed conclusions drawn from the research are discussed further in chapter four.
CHAPTER FOUR: RESULTS

Introduction

This action research study investigated students’ attitudes and participation in an elementary third grade science classroom. An action research design was selected because it creates opportunities, via personal reflection and data analysis, to improve the educational experience of students (Mills, 2003). Nineteen third grade students voluntarily participated in the study during the fall of 2005. This chapter discussed the effects gender groupings had on elementary students’ involvement and attitudes in science inquiries. Data revealed which student groups, same or mixed gender, promoted positive attitudes, encouraged participation, and enabled equal opportunity for all group members to participate.

Data collection methods for this study were: surveys, student focus groups, student journals, and teacher-researcher observation notes. Using multiple data sources allowed for triangulation of data across research methods. The research questions for this study were:

Question #1 What were students attitudes toward science?

Question # 2 During science lessons, what were students’ attitudes while in same-gender groups?

Question # 3 During science lessons, what were students’ attitudes while in mixed-gender groups?

Question # 4 How did students participate in science while in same-gender groups?

Question # 5 How did students participate in science while in mixed-gender groups?

At the beginning and completion of the research, students completed surveys that provided data on their attitudes as well as participation during science lessons. The Draw A
Scientist Test and a Science Attitude Survey (Pierce, 1999) were used to collect data on students’ thoughts and reactions as they participated in gender-based groups. Students also wrote in their science journals and participated in focus groups. Classroom observations and field notes completed the data collection process. The following section presented an overview of a typical science class period and the data analysis aligned according to research questions.

A Typical Science Class

A typical science class involved students working in gender based, cooperative groups. In some inquiries students were responsible for manipulating tools, observing, and recording their own data with a partner. In other inquiries students worked in larger groups of four or five to explore, discuss, and record findings. Inquiries began with engaging the students using a question, presenting an object to inspire curiosity, or leading a brief demonstration. Tools were introduced and students had several moments to manipulate and examine the tools before continuing. I then involved students in proposing theories and making hypotheses relating to the topic of the inquiry. Students next explored to find solutions to the teacher-posed question. After students shared ideas with group mates, the class was refocused to collectively share ideas and allow me to introduce and explain key terms or concepts of the inquiry. The following day students would continue to explore the same concept but were challenged to extend their understanding by applying the information to a slightly different task.

These third grade students had very little previous experience in studying science curriculum in their primary schooling, according to students and parents. In these early primary grades science exposure is limited to an occasional teacher demonstration or field trip. Science based themes are integrated into the curriculum, however regular science-based activities are not
part of that curriculum. Through conversations with colleagues I learned first and second grade immersed students in a literature-based curriculum that allotted only minimal time for science instruction. The third grade curriculum presented many first-time opportunities for students to explore scientific thinking and I was particularly interested in the students’ initial attitudes and the development of those attitudes as the study progressed.

Science Attitudes

Research Question #1: What were students’ attitudes toward science?

To fully understand the students’ attitudes and participation in their gender based groups, it was necessary to first understand the beliefs the students held from both prior knowledge and exposure to various media, such as books, television, and the Internet. In this class, not all children were able to fully express themselves verbally. Because of the difficulties some students had in expressing themselves in words all students completed the Draw A Scientist Test (DAST). It was given at the beginning and end of the study to gather data on students’ views on science and scientists.

Prior to any science instruction, students were given the prompt; “Draw a scientist.” They then drew their interpretation of a scientist and the environment in which a scientist worked. To clarify the drawing, students wrote a sentence describing what they drew. Responses were sorted by gender then analyzed for repeated ideas. In particular, race, gender, and other stereotypical media personifications of scientists and their roles were noted.

Female students’ responses covered a wide range of ideas including scientists working to find “how high a shark can jump”, “being a food maker” and “making a new bug” to more traditional responses like, “finding a cure for the common cold”. The idea that chemicals play an
important role in science was noted three times when girls reported their scientist, “mixing and testing”, “making stuff fly”, and “using chemicals to turn off lights”.

**August Draw A Scientist Result**

![Figure 1: Girl DAST Sketch in August](image)

Male students also mentioned the connection between science and chemicals, but boys used the word “potion”. Four boys listed their scientist as making a potion to A.) “turn you into frogs”, B.) “make volcanoes”, C.) “help you in math”, and D.) “make you smart”. Other responses written by boys included scientists making an array of products like: a time machine, new colors, worm holes that acts as teleporters, light, and a light orb & test gun.
August Draw A Scientist Result

The data supported that these students had several gender biases as suggested in the science and gender research based literature. Of the nineteen results, all nineteen students drew Caucasian scientists. Data also showed that students’ conceptions of scientists were typical gender stereotypes of white males.

Girls DAST Gender Results

Figure 2: Boy DAST Sketch in August

Figure 3: Girls Pre Study Draw A Scientist Gender Results
Additional examination of the drawings and captions revealed clues, beyond gender stereotypes of scientists, about students’ ideas of scientist and their responsibilities. Seven female participants drew their scientist working indoors and six of those contained drawings of potions and chemicals. Eight male participants drew their scientists working in an indoor lab and six of those contained illustrations of potions or chemicals. Contrary to the gender stereotypes of traditional children’s media which personifies scientists as crazed or mad, only 2 participants, one male and one female indicated a ‘mad’ scientist by drawing scientists with wild, wiry, disheveled hair.

In the post study Draw A Scientist Test, only slight changes of perceptions were noticed. Caucasias was still the dominant, and only, race of all scientists. Students, both boys and girls, increased the number of female scientists they drew in their post Draw A Scientist Test.
December Draw A Scientist Result

Figure 5: Girl DAST Sketch in December

Girls DAST Gender Results

Figure 6: Girls Post Study Draw A Scientist Gender Results
To gather additional data on students’ attitudes and participation, selected survey items were completed from the Pierce Science Attitude Survey (1999). This survey provided data on students’ pre and post study perspectives on their attitudes and participation in science class by ranking their opinion on a Likert scale with indications ranging from strongly agree (5) to strongly disagree (1). Although the survey consisted of twenty-one questions, only the 6 that
most closely related to students’ attitudes toward and participation in science were examined. The questions focused on were numbers 1, 5, 6, 10, 12, and 13. The following illustrated the degree to which students’ science attitudes changed over the course of the study as those attitudes related to each research question.

Before breaking down students’ ideas on specific aspects of science learning, I first wanted a broad assessment of students’ attitudes toward learning. Students were asked to respond to the statement, “Learning is boring”. For the purpose of this work, strongly agree and strongly disagree responses were combined with agree and disagree, respectively, because the students had difficulty distinguishing the degree of separation between the two.

![Figure 9: Pierce Survey Question # 1](image)

Figure 9: Pierce Survey Question # 1
In the initial pre assessment, of the 19 participants, ten disagreed or strongly disagreed, 6 agreed or strongly agreed with the statement, while 3 students had no opinion. Of those that indicated no response, two were boys and one was a girl. In the post survey, 13 of the 19 students indicated they disagreed with the statement, “Learning is boring”. One girl and two boys agreed while 2 boys had no response. Overall, girls showed a slight increase in their attitude toward learning whereas boys remained consistent, with no perceived change in their thoughts over the course of the work.

**Students’ attitudes toward gender based science groups**

Research Question # 2: During science lessons, what were students’ attitudes while in same-gender groups?

Analysis of the data on students’ initial attitudes when they worked in teacher-assigned, gender-based groups introduced the first theme of the work: Students’ initial attitudes were not congruent with their attitudes after completion of the study. Additional research focused on concise aspects of events that may have affected students’ attitudes and participation in this elementary class.

**Same Gender Group Attitudes**

Data from surveys, journals, and focus groups indicated both boys and girls felt it was best to work in same gender groups. However, their reasons for wanting to work in same gender groups varied. Each time students were told they would work in same gender groups, girls reported wanting to work with friends because of the support they provided each other. Girls’ stated working within the same gender group was best for them because their friends were “nice”
to them and “they listen to the teacher”. The following excerpt of a focus group expresses a common point-of-view.

“I like working with girls because they are my friends and don’t argue so much. When I work with girls we usually get done quicker. When you work with girls you probably won’t get in trouble because they are more cooperative. There was really nothing bad about working with girls. It was fun and we had a good time. I do like work (sic) with girls. It’s great!” (focus group, 11/17/05)

Boys also enjoyed working with friends but were more interested in laughing and playing than focusing on the lesson. When boys were asked why they enjoyed working with other boys, rather than girls, a common response was “my friends make me laugh and we have fun”.

Research Question # 3: During science lessons, what were students’ attitudes while in mixed-gender groups?

Mixed Gender Group Attitudes

When in mixed gender groups, boys and girls reported vastly different attitudes about working within the assigned mixed gender group. Data showed girls frequently reported initially positive attitudes about their willingness to work in mixed gender groups. When asked how they felt about the groups, girls responded with answers such as, “It’s fine” or “It’s good”. However, that positive attitude toward the group was affected by the personalities and communications of the boys within that group. Girls were concerned with the outgoing, and sometimes dominate personality of the boys.
A typical response on the more extraverted nature of boys illustrated a common theme of girls’ point-of-view after working in a mixed gender group.

“Boys and girls are nice to work with. If you work with boys and do something they don’t like you start over again. Boys always in science try to be the know it all. And girls just let them go by.” (student journal, 10/18/05)

Other girls in the class expressed similar concerns about working in mixed gender groups.

“ I did not like working with boys because boys were always first. I never did anything. They always fought. I always got bad jobs.” (student journal, 11/15/05)

“Ryan was kind of bossy. We didn’t get it done because Ryan wanted to do everything. He would always say you can’t do this let me do this. All you guys just watch but we never got it done.” (student journal 10/03/05)

Boys, conversely, were initially more negative about working with mixed gender groups prior to the activity. Boys asserted they were not pleased to be working with a girl, not verbally as their female classmates, but rather physically. When students were shuffled to form mixed gender groups, and a girl approached a table, typically, boys scooted their chair sideways, to avoid being in close proximity to the girl. As a result, some girls had their feelings hurt by this acting out and asked to be moved to another group.

One boy expressed his thoughts on working within a mixed gender group, “Working with mixed gender is horrible because you could get your worst enemy.” Another pointed out the girls trying to assert power over the boys as a cause of concern in mixed gender groups. “I don’t like working with girls because they decide whether the answer is right or wrong.” Yet another boy pointed out “working with girls is boring”.

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One girl in the class was having difficulties working in same gender groups and found working in mixed gender was best for her. She indicated she felt more accepted in mixed gender groups.

“I was pleased to git (sic) with girls and boys it seemed like the girls were niser (sic) to me when the boys were around. I guessed the girls had a little crush. I liked the mixed gender groups because if one of the girls start to be meen (sic) to me the boys take up on my side because I back down because I am smaller than most of the girls in our class. When it is mixed gender groups I get included in most of our projects and I feel like part of the class.” (focus group, 12/14/05)

Students’ group participation and resulting attitudes

Students’ attitudes on their groups changed regularly, depending on their personal moods, the topic to be studied, and the group they were assigned. The one constant factor remained despite difficulties in working with classmates, students universally wanted to continue to work in groups and have the responsibility of discussing their inquiries with classmates.

![Bar chart showing students who affirmed talking aids in learning](image)

**Figure 10: Pierce Survey Question # 5**
The Pierce Science Attitude Survey asked students to indicate their belief on discussion with a partner, not gender specific, to increase science understanding. Specifically, the statement read, “When I talk things over with my partner I understand more about what I am learning.” Ten boys and nine girls responded to the statement. In the pretest, 5 boys felt talking with classmates did not affect their understanding of the topic. One boy did not respond to the question. Out of the 9 girls that responded to the pretest question, 3 felt discussion would not improve their understanding.

In the post survey, the girls’ attitudes jumped to 100% agreement with the idea talking aided in understanding. The boys’ attitudes on discussion changed slightly, 70% of the boys indicated discussion was useful in science groups and 30% had no response. Despite the fact the data showed only small changes in students’ attitudes toward discussion, it is noteworthy that in the post survey, no student indicated they disagreed with the statement that talking aided in learning.

Results of student-to-student participation

Research Question # 4: How did students participate in science while in same-gender groups?

As the data for the final two research questions was studied, two additional themes emerged. The second theme indicated the degree to which a student participated in the group activity or inquiry directly related to the attitude that student had about both science and working with peers. A third and final theme noted the relationship between the frequency and type of student-to-student interactions and the affect on attitude and participation.
Same Gender Group Participation

As students improved their comfort level with the science inquiries and their role within the groups, they were better able to elaborate on what they felt was successful and what was unsuccessful about each particular group. While girls enjoyed the comradery that went along with shared experiences in inquiries to build friendships, their positive feelings about working in same gender groups went beyond friendship. Data showed girls repeatedly declared sharing was a critical aspect of the group work that could either make or break the success of that team. Girls were able to be flexible in their responsibilities within a group as long as they felt ideas and responsibilities were shared equally. Girls were more likely than boys to first discuss, then implement, a plan of action. In an inquiry where groups had to decide, amongst other things, the order of rolling cans down an inclined plane and responsibilities for measuring the distance for each can, a girl discussion showed how seriously they took the responsibility of sharing to ensure equality:

Michelle: “I think we should just go around the table.”
Sophia: “No, because then you go first and you always go first.”
Michelle: “How else can we do it so everybody gets a turn?”
Carly: “We could go Rock, Paper, Scissors”
Alexandra: “Yeah, that way we all get a turn.” (10/6/05)

As soon as the girls felt an acceptable system that promoted equal opportunities was devised, they were able to execute their plan and conduct their inquiry. It was interesting to note, despite the seemingly diplomatic means to order the responsibilities and participation of the
group, not all girls were happy with this system of self imposed responsibility within same gender groups.

In the pre survey, 100% of girls stated they felt *talking* only with girls was best, but in the post survey this number declined to 88%. However, when asked to *work* in a group with only girls, responses indicated a split results in the pre survey with 55%, 5 girls, indicating was best to *work* only with girls. At the time of post survey, the results jumped to 77%, 7 girls, indicating they favored working only with girls.

Boys, initially, did not have the same diplomatic manner of establishing an order for who would go first and who would have certain responsibilities within same gender groups. Despite my continuous redirection to not play with tools until all had been handed out, boys would constantly dive into the box of supplies to see what was there. The boys would establish their order of turn-taking based on who had a particular supply in hand when the use of that supply was explained. Inevitably, this led to arguing within the groups because those that had supplies in their hand during the time of explanation were not following the directions to leave the tools in the box. Boys that did follow the procedure voiced their concerns by calling attention to the fact they were listening and following directions so they should get to go ‘first’.

Mike: “It’s not fair that Tim always gets to go first.”

Ms. Parks: “Why does Tim always go first?”

Mike: “Because he always takes the supplies before anyone else.”

Ms. Parks: “How could we change the group procedures to make sure everyone has a chance to participate?”

Mike: “We could try taking turns.”
Ms. Parks: “How could you arrange the turns so everyone has a chance to go first?”

Mike: “I think we could go around the desks, one at a time.” (Measuring Mass, 10/20/05)

Despite these hurdles in working in same gender groups, 90% of the boys indicated in both pre and post surveys they believed working in groups of only boys was best.

While teamed in teacher-generated, same gender groups, boys consistently cited lack of cooperation as a major problem within the group. In their free response journal entries, boys frequently reported arguing as a cause for lack of participation. Boys responded, “Not everyone got to help”, “I felt left out”, “There was fighting”, and simply, “There was arguing”. Of these numerous indications of difficulty the most prominent was the notation of arguing. Boys indicated others were being “bossy” and that lead to an unequal participation. Interestingly, the several students that were reported as being “bossy” also reported feeling the others in the group were being “mean to me”.

The more outspoken boys needed constant redirection when in same gender groups to not take action that impeded their classmates’ opportunities to participate. Boys that were not as gregarious as their peers would cite frustrations when the more active boys were not paying attention to procedures or playing with science tools. The boys that were on task claimed the off task behavior of the group caused the entire group to miss the directions which led to not knowing what to do during the inquiry. That uncertainty led to arguing which lessened both the participation and positive attitudes of the entire group.

During an inquiry on simple machines, students created a lever and used it to lift loads of varying masses. The load students worked with were both interlocking cubes and 1-inch x 1-inch
ceramic tiles. Although students were to rotate jobs so all had an opportunity to manipulate all tools, the boys focused on the aspect of going first.

    Sam: “It’s not fair that Paul gets to go first just because he has all the blocks.”
    Ms. Parks: “Paul, how did you get all the blocks?”
    Paul: “I was going to share them, I just didn’t have time.”
    Ms. Parks: “How can we make sure everyone has a chance to work with the tools?”
    Paul: “I can give half the block to Sam and we can divide the tiles up so we all have the same number.”
    Ms. Parks: “That’s a good plan. I suggest we start with Sam and work our way around the table that way everyone gets a chance to try a new part of the activity.”
    (Lifting with Levers, 12/8/05)

In similar fashion to the boys, girls too reported the adamant nature of a single group-mate consistently affecting their abilities to communicate and interact as a group. Girls expressed similar concern about the equal opportunity to actively participate during the science inquiry. Although there was less mention of arguing, when a problem with a group mate occurred in girl groups, the perpetrator was specifically pointed out.

    Sarah: “When Nicole is in our group it is not fun. I don’t get to do anything.”
    Ms. Parks: “Why don’t you get to do anything?”
    Sarah: “Because Nicole doesn’t listen to anybody. She always wants to do what she wants to do and doesn’t listen to anybody else.”
    Ms. Parks: “Have you asked her to try and listen to everyone’s ideas before you plan the investigation?”
Sarah: “Yeah, but won’t listen. She won’t even let us talk and now she is mad that I’m telling you.”

Ms. Parks: “Is there another way to solve this problem besides me talking to Nicole?”

Sarah: “You could move me and Jen to another group.” (focus group, 9/14/05)

This excerpt of a dialog is a sample of usual concerns girls had while working together. Within the same-gender groups, girls regularly reported one specific classmate as the cause for the difficulty in the group and requested to be removed from her group.

Girls grouped with this particular student expressed a marked decrease in their enjoyment and ability to participate because they could not effectively communicate with this one student and a majority of time was spent either asking for teacher help or arguing with the student to try and get her to see another’s point of view. Data in both journals and focus groups showed on days when girls were grouped with this student they expressed a decline in both their usually positive attitude toward science and the degree they were able to participate in the inquiry.

Both boys and girls in same-gender groups reported difficulties working with classmates. Girls reported feeling left out if a classmate tried to exert her will too forcefully. Girls routinely asked to be placed in a group that did not have one particular girl in it because of her difficulties communicating fairly with her classmates. This student was singled out by female classmates and criticized for being too ‘bossy’. Boys, on the other hand, also experienced classmates trying to exert power over each other, but handled it differently. When in same gender groups, boys linked themselves as a collective group. When one classmate was redirected for being off task, the others in the group felt they too had been spoken to and mentioned, “We got in trouble for
playing with the blocks” or “The group did not pay attention” instead of singling out the one student who was off task.

Research Question # 5: How did science participate in science while in mixed-gender groups?

Mixed Gender Group Participation

Students’ journals paired with observation during inquiries provided detailed data on students’ participation when they worked in mixed-gender groups. All students expressed hesitancy, throughout the study, when assigned a new group, especially when that group was mixed gender. Girls generally remained more positive about the experience before and after the inquiry by optimistically stating they hoped “everybody will get along”. However, girls did worry about being left out. Specifically, if a particular boy was over confident in his abilities he excluded the girls from the group by moving supplies and tools out of their reach and even turned his back on them. One student journal exemplified this common frustration of girls,

“I did not like working with boys because boys were always first. I never did anything. They always fought. I always got bad jobs and the greatest grade with mixed was C+ or B-” (student journal, 9/15/05)

After completing a mixed gender inquiry, girls typically conjectured, “Boys get very bossy. They do not like to share.” When girls asked me for help, the boys were upset because the girls “Got us in trouble”. This difficulty in sharing supplies was never overcome and was a reoccurring problem of mixed gender groups throughout the study.
Perhaps because they were worried about girls getting them in trouble or perhaps they felt the girls were too serious, data showed boys regularly reported being unhappy about working with girls before and during the inquiries. During a focus group, one boy explained the difficulty working in mixed gender groups,

“I don’t like working with girls because they decide whether the answer is right or wrong. They get us in trouble too” (focus group, 12/14/05).

Curiously, after the inquiry was complete, boys regularly reported enjoying the mixed gender group because everyone shared and there was little arguing. The patterns that developed during observations of both same and mixed gender groups showed that the degree to which a student participated in the group activity or inquiry directly related to the attitude that student had about science and about working with peers.

Participation in mixed gender groups was a bit more equal despite students’ initial misgivings about the groups. When asked to record their initial thoughts on being placed in mixed gender groups’ results were similar; responses were mixed. In inquiries that were mixed gender, data showed girls’ responses generally indicated they had a more positive outlook on the group. Frequently girls indicated they believed the group would be “nice”, “fun”, or “OK”. A sample from a typical girl’s journal entry exhibits those positive attitudes:

“I like working with girls and boys because you can see what it is like to work with boys. One thing is they argue. Even though they argue sometimes you get along. It is still fun. With boys and girls you have friends” (student journal, 11/14/05)

Boys, conversely, stated their mixed gender group would be “horrible,” “bad”, or “weird”. 
“It is sorta (sic) boring working with girls because you could get your worst enemy. Working with sum (sic) girls is OK but mostly I disagree more with girls than boys” (student journal, 11/29/05).

In the weekly feedback forms and journals, students were asked to reflect on the inquiry and focus on their attitude and participation within the mixed gender group. Girl attitudes remain positive with responses like the group was “fine”, “great”, or “fun”. Boys reported a more positive attitude after the completion of the inquiry by responding the group was “OK, fine”, and “good”.

Figure 11: Boy Journal

During a focus group students were able to reflect and express several common points of view on mixed gender groups predication.
Kyle: “I like being in boy groups because I don’t like to being surrounded by girls! It would be better if they didn’t argue and stayed calm and listened to the person that was talking.”

Ms. Parks: “Is not being listened to a problem in both groups?”

Kyle: “Not as much. The only thing I like about working with boy and girl groups is we don’t argue a lot because the group gets along better than boy groups.” (focus group, 11/30/05)

The resounding theme participants stated as affecting their participation, and in turn, attitudes, was the amount of arguing that occurred within the group. Students, regardless of gender, reported the most positive interactions and attitudes when each student was able to participate as equally as everyone else in their assigned group.

**Summary**

The purpose of this study was to examine how students participated in gender-based groupings and the attitude of these third grade students. Analysis of data revealed several themes about students’ thoughts, attitudes, and participation as they worked in same and mixed gender groupings during the first half of the school year. The first theme discovered was that students’ initial attitudes about working in teacher-assigned, gender-based groups did not correspond with their attitudes after completion of the inquiry. The second theme was that the degree to which a student participated in the group activity or inquiry directly related to the attitude that student had about both science and working with peers. A third theme was the frequency and type of student-to-student interactions directly affected attitude and participation.

When studied cumulatively, the data from students’ responses in surveys, journals, and focus groups, combined with teacher-researcher observations indicate these third grade students
have a positive attitude toward the study of science regardless of gender. Gender had little affect
students’ participation, however the students' ability to effectively communicate with classmate
without arguing did affect attitude.

In chapter five, a discussion of the findings and conclusions drawn from those findings
were discussed. A call for further research was also indicated.
CHAPTER 5: CONCLUSION

Introduction

Being personally aware of the challenges and difficulties girls and boys may face as they study science made me acutely interested in looking at the initial science attitudes and participation of third grade students as they began their science classroom experiences. It is important for all students, regardless of developmental level, age, or gender to have the opportunity to participate in science inquiries (NRC, 1996). The aims of this action research study were to analyze students’ attitudes toward and participation in elementary science class as they were grouped in alternatively in same and mixed gender groups.

As the study proceeded I became more aware of the necessity to create equal opportunities for both discussions and participation in elementary science class. I observed how students interacted and communicated while in same and mixed gender groups. Observations, paired with collected data, led me to analyze how those student groupings impacted learning in science classes.

The research questions were:

Question #1 What were students attitudes toward science?

Question # 2 During science lessons, what were students’ attitudes while in same-gender groups?

Question # 3 During science lessons, what were students’ attitudes while in mixed-gender groups?

Question # 4 How did students participate in science while in same-gender groups?
Question # 5 How did students participate in science while in mixed-gender groups?

Throughout the study students generated data in a series of surveys and journal entries. Additional data were generated in student focus groups and observations. At the end of the study, post assessments on students’ attitudes and participation were administered and compared to pre study data. Results of triangulated data produced three themes, which were related to the research questions. The themes were: students’ initial attitudes about working in teacher-assigned, gender-based groups did not correspond with their attitudes after completion of the inquiry, the degree to which a student participated in the group activity or inquiry directly related to the attitude that student had about science and about working with peers, and the frequency and type of student-to-student interactions directly affected attitude and participation.

Conclusions

This study took place in an elementary school in Broward County, Florida. Data were collected from nineteen third grade participants. Based on my analysis of the data generated over the course of this study I offer conclusions as they relate to each of the research questions.

Research Question #1 What were students’ attitudes toward science?

Contrary to Morrell and Lederman’s assertion that “Student attitudes toward science are not positive” (1998, p. 81), these students expressed attitudes of excitement and eagerness toward the study of science. As this study progressed, students’ attitudes toward science remained positive. Students began this research project with little formal science experience. They were excited with the new opportunities and responsibilities entrusted to them over the
course of the study. Degree of difficulty of a certain task or the lack of understanding of an idea did present a lessening of their positive attitudes. For example, when girls felt overwhelmed by a certain aspect of a task, they would ask for the teacher’s assistance. Once they understood how to proceed, the girls were able to independently carry on with the activity. Boys, on the other hand, would not seek out the teacher’s assistance, but rather amuse themselves by playing with the science tools until the teacher approached. With the teacher’s attention, the boys would explain they were not interested in the task because it was “too hard” or they “didn’t get it”. Boys were not as eager as girls to redirect their attention and try to figure out the task, even with teacher guidance. However, when an individual student was able to connect to the topic at hand and was able to assume a leadership role, that student’s attitude skyrocketed.

Question # 2 During science lessons, what were students’ attitudes while in same-gender groups?

Data showed both boys and girls indicated they had positive attitudes while working in same-gender groups. Attitudes remained positives, as long as the inquiry was progressing smoothly. When the groups experienced challenges the gender-based teams responded very differently. Girls for example, were quick to single out the source of the problem while distancing themselves from her. Boys, contrarily, bonded together, with the source of the problem. Boys would report, as a team, “we” made a bad choice, whereas the girls would report, X made a bad choice.
Question # 3 During science lessons, what were students’ attitudes while in mixed-gender groups?

Although mixed-gender groups began with the most hesitancy, they ultimately provided the most frequent opportunities for all participants to participate in the inquiry. In mixed gender teams, rarely did a single leader arise, rather students worked cooperatively to keep all ‘in check’. Girls were more apt to suggest ways in which all could equally participate by either taking turns by arranging the order by name or using Rock, Paper, Scissors. Boys readily agreed with suggestions because they understood it promoted equal opportunities for all to participate.

Question # 4 How did students participate in science while in same-gender groups?

Based on my analysis of the data, particularly students’ responses to surveys and journal writings, I found it was necessary to have equal student participation to maximize science learning and enjoyment. Regardless of whom they were teamed with, students repeatedly and adamantly stated the necessity of working with peers to enhance their learning experience. At this age, students had great difficulty obtaining equal participation on their own within their cooperative groups so it was essential I created opportunities for all to participate. However, students did note their participation was directly linked to the fairness and sharing the particular
group generated. Both boys and girls were excited when told they would be working in same
gender groups. That initial excitement, however, was often over shadowed by one or two events
that inevitably tainted the student’s point of view on the entire experience.

Girls regularly singled out one classmate and requested to be in an alternative group
because one classmate was too difficult to work with. Despite my initiatives and team building
attempts, this one particular student was either unwilling or unable to listen to the ideas and
strategies of her classmates without feeling like her own ideas were being negated.

Boys were rarely reluctant to work with their same gender peers. In fact, the opposite
seemed to be true. The few boys that were considered ‘popular’ by peers were also the boys that
exhibited the most challenging behaviors. These boys that frequently disregarded established
procedures, such as not touching science material until instructed to do so, and grabbing supplies
without talking with peers first, were regularly the most sought after group-mates. When one of
these energetic boys was placed in a group, most of the boys in that group smiled and laughed,
indicating they thought this group would have lots of fun and excitement. When boys were
working in same gender groups, the top priory, as reported in focus groups and journals was
working with friends. If boys perceived their group was made-up of classmates they considered
friends, then that group was successful and was ranked as highly likeable.

These results are consistent with the findings of other gender and science researchers.
Thorne asserted that girls value cooperation in cooperative groups while boys value competition
(1994). Same gender girl groups waited for each other as well as teacher directions and worked
together to plan their investigations. Same gender boy groups had great difficulty acting as a unit
and working together as a group. Individual boys would regularly assert themselves, and their
perceived expertise, in order to take control of the group without regard to the opportunities they were eliminating from their group-mates.

Question # 5 How did students participate in science while in mixed-gender groups?

Although boys expressed reluctance to work with girls prior to the science inquiry after the task was complete and boys were working on the reflective summary, they frequently reported the group was “not that bad”. One of the most regularly reported advantages of the mixed gender groups, according the boys’ journals and my observations, was the lack of fighting or arguing. However, the description of the group did not translate into the boys acknowledging the girls as friends after they completed the task.

In our focus groups and journals, girls initially experienced hesitation about working with the boys because they feared they, “wouldn’t get to do anything”. Contrary to their fears, after the conclusion of the science activity, girls reported the group was “fun”. When encouraged to express additional details, girls articulated their thoughts that told the opportunity to participate was present and they were happy to have turns to participate with classmates they did not know as well as others they had worked with previously. Girls further indicated they believed they had now become “friends’ with their classmates because of the bonding that took place as they worked together.
Discussion

The aim of this research project was to study students’ attitudes and how they participated in science during different gender groupings. Findings discovered by the data were surprising to me. The research project began with an assumption that gender would play a significant part in students’ attitude and participation in science inquiries. Perhaps, as Thorne suggests, because of the students’ age, gender was not the main factor in influencing attitude or participation (1994). It did manifest in several different areas, but was not the dominant factor. Rather, communication and equal opportunities were the main influences that affected students’ attitudes and participation. Students were generally happy to work with classmates as long as they felt they were a valued part of a team and their opportunities to participate were equal to those of their group-mates.

Based on the data provided in this study, I believe a combination of, teacher-student and student-student successful communication hold the key to creating and keeping positive attitudes and equal opportunities in the science classroom. As a teacher, it is my responsibility to create classroom norms that will help my students learn to express themselves in a manner that promotes respect and fairness with their peers. Students learn best while experiencing topics for themselves and it is my responsibility to create classroom norms within the school environment that is conducive to a large community of learners (Alkove & McCarty, 1992).

Classroom norms, established cooperatively by the students and teacher, refer to the expectations of actions and communications in the classroom (Stephan & Whitenack, 2003). In my classroom these norms include respectfulness, patience, cooperation, curiosity, courage, and
integrity. These life skills provide the basis for each child to begin constructing solid scientific knowledge by connecting with classmates and reflecting on prior experiences. Once classroom norms have been established, students are free to explore and question ideas individually and as part of both small and large groups without worry of failure or criticism. Through fairness and proper communication, students will learn to present and listen to theories and ideas via well thought out discussions that promote scientific thinking and understanding.

This research study enabled me to guide my students’ initial science experiences in a manner conducive to promoting enjoyment and positive attitudes towards the study of science. By direct observation and student feedback I was able to learn what made science enjoyable and what students valued as important to their learning. By reflecting on this study I was able to modify my teaching to improve my students’ experiences in and beyond the science classroom.

The results of this study have enabled me to see the importance of being aware of the affects of gender in the classroom and the roles associated with gender identities. I have shared my findings within my school community, to both colleagues and parents in hopes of promoting the need to be cognizant of gender biases and maximize classroom groupings in a manner that best facilitates the construction of knowledge, for my students and the students in the larger community of the elementary school.

Over the course of this study I became increasingly aware of the degree to which students’ social interactions directly influenced their science attitudes. Through my reflections and analysis of the data I am better able to meet the needs of my students, both socially and academically, regardless of gender or ability. There is more research needed to continually
improve my teaching and I will continue to study the affects of gender in the elementary science classroom.

I believe in establishing classroom social norms and frequent student-teacher communication to allow students to reach their personal best academically and socially. Once teachers recognize the extent gender plays in classroom discussions and participation they can move toward addressing the gender roles in the classroom (Bianchini et al., 2000). In order to become facilitators of student learning, teachers must be aware of the multitude of ways in which gender affects student participation and attitude. If teachers make a conscious effort to become more aware and knowledgeable of gender equity issues in the inquiry classroom, adjustments can be made to improve the science experience for all students. Inequity in science classrooms is a problem that can be fixed (Gilbert, 2003). However, more research is needed to explore the diversity that exists between boys’ and girls’ science experiences (Brickhouse, Lowery, & Schultz, 2000).

**Recommendations**

After conducting this action research study, I see a need for continuing to research gender and science. I encourage more longitudinal work. An abundance of data has been complied over the past several decades, but the results continue to be inconclusive (Klein, 2004; Jarvis & Pell, 2002; Patrick & Yoon, 2004). My results mirror those inconsistencies. Perhaps the children’s age played a role in the atypical data on attitudes and participation. Perhaps the classroom social structure played a role in the inconclusive nature of the findings. I would be particularly interested in a longitudinal study that began with children’s earliest exposure to formal science education and follows them throughout their elementary school years.
A study conducted with older children, approaching adolescence, may provide additional data on students’ attitudes and participation. If a larger sample size were available, the outcomes of an experimental design study where one group of participants freely chose their group mates were compared with a second group of participants that worked in teacher assigned teams detailed data could be collected and analyzed seeking information on the affects of gender in the science classroom.

I further recommend teachers begin working with students in primary grades to establish classroom social norms. These norms should mandate polite, well-mannered, social etiquette that can be transcribed into classroom communication. Proper dialog skills may then create avenues of communication without creating an intimidating or threatening environment.

Finally, teachers must be prepared to advocate the needs of their students by improving their teaching pedagogies. By asking and seeking answers to perplexing questions on the affects of gender in the classroom, teachers may learn to modify their practice and be able to improve the science experience and cement positive attitudes that fill students will curiosity for their entire lives.
APPENDIX A:

UNIVERSITY OF CENTRAL FLORIDA IRB FORM
May 27, 2005

Melissa Parks  
Department of Teaching and Learning Principles  
College of Education  
University of Central Florida  
4000 Central Florida Blvd.  
Orlando, FL 32816

Dear Ms. Parks:

With reference to your protocol #05-2572 entitled, “Same Gender and Mixed Gender Groups’ Participation in Elementary Science Classrooms” I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office. This study was approved on 5/26/05 and the expiration date will be 5/25/06. Should there be a need to extend this study, a Continuing Review form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator. Please notify the IRB office when you have completed this research study.

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board through use of the Addendum/Modification Request form. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur.

Should you have any questions, please do not hesitate to call me at 407-823-2901.

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

Cordially,

Barbara Ward  
Barbara Ward, CIM  
IRB Coordinator

Copies: IRB File  
Dr. Bobby Jeanpierre
APPENDIX B:

PRINCIPAL CONSENT FORM
August 2005

To Whom It May Concern:

I support Melissa Parks' participation in the research study, "Same Gender and Mixed Gender Groups' Participation in Elementary Science Classrooms", which will be conducted by Ms. Parks, as a thesis requirement for the University of Central Florida.

The focus of the study is to investigate how student gender affects student participation in science classrooms. Ms. Parks will obtain permission from students' parents prior to their participation. The academic assessment of students who do not participate in the study will not be negatively affected.

I understand that if I have any questions about this research study, I can, at any time, direct those questions/concerns to Ms. Melissa Parks, 407-249-6390, or the UCFIRB Office at 12442 Research Parkway Suite 207, Orlando, FL 32826. The phone number is (407) 823-2901.

Sincerely,

Shelly Isenberg, Principal
APPENDIX C:

PARENT CONSENT LETTER
August 20, 2005

Dear Parent:

I am currently a graduate student in the Lockheed Martin/University of Central Florida Science and Mathematics K-8 Master’s Program under the supervision of faculty member, Dr. Bobby Jeane pierre. I am conducting research on student participation in the elementary science classroom. As a graduation requirement I will conduct an action research project and document the findings in a thesis.

The focus of this research is to look into the effects gender has on student performance in the elementary science classroom. I have spoken with Principal Isenberg and gained her support.

I would like to include all of my students in this research opportunity. Therefore, I am requesting your permission for your students’ participation. If you choose to have your child participate, please check yes on the blank space below and return the signed portion of this form to me by _________. If you do not choose to have your child participate, check no in the place provided. Portions of the project may be video taped and/or recorded on audiotape. My research supervisor and myself will be the only viewers of the tapes. All tapes will be destroyed at the completion of the study. There is no penalty of any kind for those students who do not participate.

You and your child have the right to withdraw consent for your child’s participation at any time without consequence. There are no known risks or immediate benefits to the participants. No compensation is offered for participation.

If you have any questions about this research study, you can, at any time, direct those questions/concerns to Melissa Parks at 407-925-4533, Principal Isenberg at (754) 322-8200, the UCF faculty supervisor, Dr. Jeane pierre at (407)-823-4930, or the UCFIRB Office at 12442 Research Parkway Suite 207 Orlando, Fl 32826. The phone number is (407) 823-2901.

Sincerely,

Melissa Parks

APPROVED BY
University of Central Florida
Institutional Review Board
Chairman

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I have read the procedure described above. I voluntarily agree to participate in the procedure, and I have received a copy of this description.

I have read and understand the letter for participation in “Gender Roles in Elementary Science Classrooms” research study.

I give permission to my child to participate.

I do not want my child to participate.

Parent’s signature ___________________________________________ Date ______________________

I have read and understand the letter for participation in “Gender Roles in Elementary Science Classrooms” research study. I understand the teacher-researcher may videotape some science activities and the tapes will be destroyed at the completion of the study.

I give permission for my child to be videotaped during the project.

I do not want my child videotaped during the project.

Parent’s signature ___________________________________________ Date ______________________

I have read and understand the letter for participation in “Gender Roles in Elementary Science Classrooms” research study. I understand the teacher-researcher may audiotape some science activities and the tapes will be destroyed at the completion of the study.

I give permission for my child to be audio taped during the study.

I do not want my child to be audio taped during the study.

Parent’s signature ___________________________________________ Date ______________________
APPENDIX D:

CHILD ASSENT SCRIPT
Student Assent Form

My name is Melissa Parks. I am a student at the University of Central Florida. I would like to ask you to complete a science project where you build a simple machine, like a ramp. I would like to make videotape and a recording on cassette tape of this experiment. If you choose to participate or not participate your grade will not be affected. You may stop at any time and do not have to answer any questions you do not want to answer. Would you like to do this?
APPENDIX E:

PIERCE SCIENCE ATTITUDE SURVEY
APPENDIX F:

STUDENT ATTITUDE SURVEY
Student Attitude Survey (yes/no)

1. Is science fun?
2. Should girls be scientists?
3. Do you like to take things apart to see how they work?
4. Do you like to use science equipment like hand lenses and eyedroppers?
5. Do you like talking about what you did in science with girls?
6. Do you like talking about what you did in science with boys?
7. Is working with only girls best?
8. Is working with only boys best?
9. Do you like working in groups with boys and girls?
10. Do you like to talk with your teacher about science?
APPENDIX G:

HOW DO YOU FEEL ABOUT SCIENCE EXPERIMENTS?
How Do You Feel About Science Experiments?

How do you feel about watching the teacher do a science experiment?

How do you feel about figuring out how to do an experiment yourself?

How do you feel about the teacher telling you what to during science experiments?

How do you feel about choosing your own science tools to use?

How do you feel about finding out what happens in science experiments by yourself?

How do you feel about working by yourself on science experiments?

How do you feel about working with your friends on science experiments?

How do you feel about finding out why a science experiment works?

How do you feel about telling the teacher what you have learned in science?

How do you feel about telling your classmates what you have learned in science?
APPENDIX H:

WEEKLY GROUP FEEDBACK
Weekly Group Feedback – Week One

1.) Circle one. I am a boy I am a girl

2.) Choose one:
   This week I worked in a same gender group
   This week I worked in a mixed gender group.

3.) I liked working with this group...
   Very Much it was OK Very Little
   I liked the group because
   I did not like the group because

4.) I was able to have my first choice of jobs in this group.
   Yes No

5.) I answered as many questions as I wanted to in this group.
   Yes No

6.) My classmates listened to me in this group.
   Yes No

7.) I was able to work on the inquiry as much as I wanted in this group.
   Yes No

8.) I worked well in this group.
   Yes No

9.) I learned a lot from working with this group.
   Yes No

Ms. Parks should know.....
APPENDIX I:

HOW DO YOU FEEL ABOUT SCIENCE?
How Do You Feel About Science?

1.) I like to talk about science with my classmates. [Smiley faces with varying degrees of happiness]
   I don’t know

2.) Girls are better than boys in science [Smiley faces with varying degrees of happiness]
   I don’t know

3.) Boys are better than girls in science. [Smiley faces with varying degrees of happiness]
   I don’t know

4.) I like to use science tools in experiments. [Smiley faces with varying degrees of happiness]
   I don’t know

5.) I like to work in groups with my classmates on science experiments. [Smiley faces with varying degrees of happiness]
   I don’t know

6.) I like to be in charge of my group during science. [Smiley faces with varying degrees of happiness]
   I don’t know

7.) I would like to work in an all boy group. [Smiley faces with varying degrees of happiness]
   I don’t know

8.) I would like to work in an all girl group. [Smiley faces with varying degrees of happiness]
   I don’t know

9.) I like talking with my teacher about my science experiments. [Smiley faces with varying degrees of happiness]
   I don’t know
REFERENCES


