An Exploration of Teacher-Child Relationships and Interactions in Elementary Science Lessons

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AN EXPLORATION OF TEACHER-CHILD RELATIONSHIPS AND INTERACTIONS IN ELEMENTARY SCIENCE LESSONS

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To Esra Kocyigit, my wife and my best friend.

To Zeynep Kocyigit and Yasemin Kocyigit, my daughters and my greatest happiness in life.
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This study examined the nature and quality of teacher-student interactions in a third grade science classroom and investigated how interactions and teacher-child relationships relate to the learning of science concepts. The relationships between the three dimensions of teacher-student relationships (Closeness, Conflict, and Dependency) and teacher-student interactions including the dimensions explaining the nature and the quality of teacher-student interactions were examined. The study also determined whether there was a relationship between students’ conceptual understanding of science and all variables of teacher-student interactions and the teacher-student relationships. First, data from the videotape and audiotape recordings were transcribed, coded and analyzed to determine the appropriateness of the proposed interaction-types and their classification into the categories. The twelve teacher-student interaction categories used in this study were able to capture all verbal teacher-student interactions in the classroom. Second, each teacher-student interaction was placed into the respective dimension and group explaining the nature and quality of the interaction. Finally, Pearson Product Moment Correlations were computed to explore the possible relationships between the teacher-student interactions and relationships and students’ conceptual understanding of science. Teacher-student interaction scores were obtained through natural observations of eight- to nine-year-old children. Students were rated by their teachers using the STRS in order to obtain teacher child relationship scores. Similarly, conceptual science understanding scores were obtained through pre- and post-tests delivered at the beginning and end of the science unit.

The findings of the study suggested a strong relationship between teacher’s perception of her relationships with the students and the teacher-student interactions in the classroom. It appears that classroom conversations mostly take place between the teacher and the students.
whom the teacher perceived to have better relationships. However, it was clear from the observations that positive teacher-student relationships did not necessarily warrant for high quality teacher-student interactions in the classroom. The quality of the teacher-student interactions during the science lessons appeared to be more moderate than high in quality. Students’ improvement in conceptual understanding of science was rather related to the positive classroom environment and the friendly classroom atmosphere created by the teacher and did not significantly correlate with the student’s individual interaction or relationship with the teacher.
CHAPTER 1

INTRODUCTION

In an era driven by science and technology, science education has never been more important than it is today. Arguably, the future prosperity of our nation and people, as well as our success over other competing nations, relies on how we educate our children. Advances in science and technology and a shrinking more global world requires our citizens to be equipped with adequate knowledge of science in order to be successful from business to production, communication to investment, finance to technology and services. It is hardly surprising, therefore, that there has been ongoing concern for science education in the US. Since the early eighties numerous reports suggest that schools have not adequately educated students in science. Despite improvement efforts and several reform movements, the science achievement of American students seems to be lacking and U.S. students continue to perform poorly in comparison to students from other countries (Kelly et al., 2013; National Commission on Excellence in Education, 1983; National Commission on Mathematics Science Teaching for the 21st Century, 2000; Rutherford & Ahlgren, 1990). The report Before It’s Too Late, also referred to as the Glenn Report, called the current preparation of US students in mathematics and science “unacceptable” (National Commission on Mathematics Science Teaching for the 21st Century, 2000, p. 7). Following the publication of the report there were many reform efforts. Yet, U.S. student’s scientific knowledge and learning continued to be weak and superficial, and their performance in science relative to their peers in other countries remained unchanged. Students from other competing nations, however, continued to score higher than US students on tests of science achievements (National Commission on Mathematics Science Teaching for the 21st Century, 2000). The achievement gap between different ethnic groups is another concern, and
these gaps in achievement persist between majority group students and both economically
disadvantaged and non-Asian minority students (National Research Council, 2007).

The Trend in International Mathematics and Science Study (TIMSS) provided
international comparative information on students’ mathematics and science achievement. In
2003, the International Association for the Evaluation of Educational Achievement (IEA)
conducted the third comparison of mathematics and science achievement since 1995. A total of
46 countries participated in TIMSS, at either the fourth or eighth grade level, or both. The 2003
test results revealed that both US fourth and eighth graders scored above the international
average. Even though, of the fourth graders, 9 out of 15 countries showed an increase in average
science achievement scores between 1995 and 2003, there was no measurable difference
detected in the average science performance of U.S. fourth-graders. For the same time period
U.S. 8th graders were able to increase their average science scores from 513 in 1995 to 527 in
2003 and were ranked 8th in 2003 (Gonzales et al., 2004). In 2011, 57 countries at fourth grade
level and 56 countries at eighth grade level participated in TIMSS. The 2011 test results revealed
that both US fourth and eighth graders scored above the international average. There was no
measurable improvement in the average science performance of U.S. fourth-graders in 1995
(542) and in 2011 (544). Also, there was no measurable difference between the U.S. average
score in 2007 (539) and in 2011 (544). For the same time period of 1995-2011, U.S. 8th graders
were able to increase their average science scores from 513 to 525. However, there was no
measurable difference detected in the average science performance of U.S. eighth-graders in
1995 (513) and in 2011 (525). Also, there was no measurable difference between the U.S.
average score in 2007 (520) and in 2011 (525) (Provasnik et al., 2012).
The national assessment of US students in science and mathematics portrays a similar discouraging picture. The large achievement gaps between students from different socio-economical, racial and cultural backgrounds persist in all subjects. Such achievement gaps are especially strong and persistent in science (National Research Council, 2007). The academic achievement of elementary and secondary students in the United States is continually measured and the findings are shared with the public. The National Assessment of Educational Progress (NAEP) is one of the congressionally mandated projects and periodically conducts assessments in science, mathematics, reading and other subjects. NAEP science results are reported as percentages of students performing at or above three achievement levels: basic, proficient and advanced. According to the 2009 assessment of NAEP, only thirty four percent of fourth-graders, thirty percent of eighth-graders and twenty one percent of twelfth-graders showed solid academic performance and performed at or above the proficient achievement level in science. It is of some concern that one-third of the US fourth-graders and more than one-third of eighth and twelfth graders scored below the basic level and lacked the necessary knowledge and skills needed for mastery in science. Surprisingly, the average science score for the twelfth graders declined and fell behind the 1996 averages. Although, achievement gaps between students from different racial and cultural backgrounds showed minor improvement, in general the data are not encouraging. Among the fourth grade science students who scored at or above the proficient level; 47% were White whereas 11% were Black, 14% were Hispanic, and 17% were Native American. For eighth and twelfth grade science, the percentages were even lower for minority students (National Center for Education Statistics, 2011).

Improving students’ performance in science is not simply about improving our students’ international ranking. It has more to do with ensuring that our children are given adequate
preparation in science in order to function competitively in an age and world system driven by scientific and technological advancements. Over the years, national and international assessments of US students in science have taught us that students who have the benefit of skilled, creative and trained teachers and inquiry based content-rich education in science demonstrate higher levels of achievement.

Teaching science well to our children is of critical importance because science plays a vital role in improving the quality of life. All children have the intellectual and cognitive capacity to learn science when they come to school. However, we continue to fall short of providing the kind of support that our children need to develop deeper understanding of scientific ideas and engage in practices of science and methods of inquiry (National Research Council, 2007).

The National Research Council (2007) states that children from all backgrounds are able to learn science and use scientific reasoning processes as they relate to their prior experiences. Parents and teachers play a critical role in promoting children’s curiosity and supporting their learning and advancement in critical thinking. By mediating their learning attempts, providing meaningful experiences, and directing their attention, adults can stimulate children’s advancement in science. When teachers create opportunities for revealing student misunderstandings and provide structured experiences and instructional support, children will develop healthy understanding of scientific concepts. It is therefore important for teachers to align their teaching in accordance with their students’ level of exposure to science, and scientific norms and practices. Quality instruction of science requires students to participate in a range of activities that promote investigatory forms in science. Science taught as inquiry should allow
students to generate questions, develop methods of studying phenomena, hypothesize, analyze and interpret data (National Research Council, 2007).

As part of their natural curiosity, children develop a set of ideas about the natural world and accumulate experiences before they enter science classrooms. The prior knowledge and experiences should be evaluated and aligned toward classroom practices where the necessary conceptual changes and skill development can occur. Instructional goals and objectives and teaching itself must recognize the role of student’s prior knowledge and skills on their learning. A teacher therefore needs to create a learning environment that moves each child’s understanding of science and skills to a higher degree, and provide support for children’s participation in scientific practices in the classroom. The learning environment has a series of vigorous effects on students’ views of themselves as science learners and their sense of belonging in a supportive scientific atmosphere of a science classroom, and their willingness to participate in science activities (National Research Council, 2007).

In order to improve student outcomes, it is important to examine the learning environment that is created and maintained by teachers, and the interactions and relationships among teachers and students. In classrooms, teachers and students spend a considerable amount of time interacting with each other and a good relationship between teachers and students is necessary for student advancement in cognitive abilities, as well as other affective learning outcomes (National Research Council, 2000, 2005, 2012). Furthermore, interactions are essential hooks that engage students to science concepts. Asking questions such as “Where do we come from?”, “Why is the sky blue?”, and “What is the smallest piece of matter?” is particularly important for students in the early grades to build an interest for science (National Research Council, 2012).
It has been reported that most elementary teachers are uncomfortable with teaching science, and that they often believe that it is less important than other subjects (Weiss, 1987). Teachers are also often blamed for student failure in science with inappropriate science instruction cited as a particular problem. Many researchers agree that elementary school teachers lack the necessary skills, or that they do not have enough conceptual and factual knowledge to teach science. Furthermore; elementary science has been described as containing content that is inaccurate, standards that are too low, lessons that are irrelevant to students’ lives and instructional strategies that favor some learners over others (Aldridge, 1992; Driver, 1988; Eylon & Linn, 1988; Tobin, 1990; Wenner, 1993).

Teachers with insufficient science background along with limited resources and facilities seem to contribute to inefficient science teaching in elementary classrooms. Studies suggest that elementary school teachers have limited knowledge in the area of science and that they do not provide opportunities for hands on activities. This is surprising because it is well established that inquiry, and practical activities are necessary ingredients for developing science understanding and competency in young children. Possibly, the lack of content knowledge and science experiences cause many elementary teachers to experience difficulties while guiding their students toward a solid understanding of science that is free of misunderstandings. Many teachers fail to identify and correct student misunderstanding which, in turn, prevents them from teaching science effectively (Duschl, 1983; Ginns & Watters, 1995; Tilgner, 1990).

Many teachers believe that they need sophisticated equipment to teach science and that science concepts are too advanced for elementary students (Cronin-Jones, 1991; Schwartz, Abd-El-Khalick, & Lederman, 1999; Weiss, 1994). About one fourth of elementary teachers do not provide any time for science teaching. Those that do teach science spend less than two hours
each week because they dedicate all their remaining time to other disciplines (Raizen & Michelsohn, 1994; Tilgner, 1990). According to Weiss (1994) fewer than a third of elementary teachers felt they were well qualified to teach science, and they spend only 27 minutes per day on the average teaching science. In her study, it was found that teachers emphasized textbook driven factual learning where “… the largest proportion of class time was devoted to lecture/discussion (38% of class time), followed by hands-on/laboratory work (23%), individual seatwork (19%), non-laboratory small group work (10%), with the remaining 10% of time spent on daily routines, interruptions, and other non-instructional activities” (Weiss, 1994, p. 13).

Elementary students spend most of their school time in one classroom interacting with their peers and with their teacher. Thus, enhancing the quality of their interactions and relationship with their teacher may provide the means for creating a positive classroom environment and a more desirable social atmosphere that is necessary for generating students’ interest in science. Although it is well established that teacher-child relationships are important in elementary classrooms, little is known about how teacher-student relationships affect student outcomes in all subject areas, particularly in science (Lynch & Cicchetti, 1997).

It is important for researchers to understand the factors that influence students’ learning in elementary school settings. In traditional classrooms, teachers are viewed as the main source of information and textbooks and other materials are used as the means to reinforce student learning (Appleton, 1993). Many students believe that learning is a passive process where knowledge is transferred from an external source and stored in the memory. According to this view, science is learned primarily as an accumulation and memorization of facts. Possibly, this passive process of learning is what the students think is happening at school. Classroom discussions of alternative viewpoints and negotiated agreement are not considered a part of the
learning process, and are considered as wasted time that hinders efficient progress (Baird & Mitchell, 1986). Science learning based on memorization does not necessarily result in the expected student outcomes. Studies have shown that students often experience difficulty establishing connections between concepts and using them in real-life applications, regardless of their scores on standardized tests (Yager, 1991). Thus, teaching based on factual materials solely will undermine joyful learning of students and cause them to forget what they learned in the long run (Martin 1997).

There is widespread consensus that the elementary grades are essential years for the construction of scientific knowledge needed in further education and real life. Although traditional methods still have their places as learning practices in elementary classrooms, contemporary student centered instructional practices became the focus of science classrooms during the last decade. Active learning, in particular, has been the focus of inquiry based constructivist teaching and learning where learners actively participate in the construction of knowledge that is resulted from their experience. As a student centered instructional practice, constructivism has become the leading theoretical position in education, and the most powerful dynamic force in science education in recent decades (Fensham, Gunstone, & White, 1994; Tobin, 1993; Tobin & Tippins, 1993). The constructivist perspective, in contrast to the traditional or objectivist paradigm, recognizes that science knowledge is not something that the teacher possesses and transfers to children. As teachers and scientists do, students construct science knowledge to make sense of their interactions with their world and with other learners (Dana & Davis, 1993).

The constructivist perspective in teaching has its roots in Piaget’s theory of meaningful learning that learners actively construct knowledge based on their own individual experiences
and understanding (Henniger, 1999). According to Piaget, knowledge cannot be transmitted wholly from one person to another; people must construct their own knowledge and their own understandings. Piaget believed that children constantly discover the world around them and learn through their experiences while revising their ideas and reshaping their cognitive understanding of concepts. Children’s prior knowledge and experiences play an important role in their learning. Children construct their own meaning by combining prior information with new information, such that the new knowledge provides personal meaning to the child. Piaget claimed that children’s intellectual development occurs by way of three processes: assimilation, accommodation, and equilibrium. Assimilation involves the information children already know and integration of new information to the children’s existing knowledge. Accommodation involves adjusting and altering the prior knowledge to accommodate newly learned information. Disequilibrium occurs if new information requires alterations to the prior information and continues until the children are able to assimilate and accommodate the new information and thereby re-establish equilibrium (Cobern, 1993; Lavatelli, 1973; Prather, 1993; Woolfolk, 2013).

Constructivist theory emphasizes the importance of each learner’s active construction of knowledge through their interaction with others and with the environment. In a student oriented science classroom; ideas resulting from students’ active exchange, debate, and negotiation challenge students’ views and cause students to seek for new scientific explanations (Duit & Confrey, 1996).

Active participation of learners in lessons and learners constructing their own understanding is encouraged for stimulating student learning (Martin, Sexton, & Gerlovich, 2001). It is important to examine the teacher-student relationships, social interactions and the
nature of those interactions during instruction in order to determine the factors affecting students’ scientific understanding.

Scientists and teachers agree that the best way to learn and master scientific information is to do science. Science learning is viewed as an active process that requires learners to take control of their learning by seeking answers to their questions and investigating solutions to their problems. Therefore, teachers should provide opportunities for students to express their ideas and support them in their efforts to resolve their problems. By asking and answering questions freely and participating in active hands on and minds on inquiry students can develop a long lasting science understanding (Lind, 1997).

Any negative or positive experience during the elementary school years is likely to have a significant influence on students’ future success in school and in life. The early science experiences of children may contribute to feelings of pleasure and confidence or inadequacy, frustration, and even alienation from science. Students’ future interest and performance in science is important not only for the development of their scientific understanding, but also for the prospect of our nation as a whole. Thus, investigating the teacher-student relationships and interactions and their relation to development of scientific understanding of students during elementary grades is important.

The current study examined science teaching and learning in an elementary school setting. Using observational research methods, the study explored the nature and quality of teacher-student interactions in a third grade science classroom and investigated how interactions and teacher-child relationships related to the learning of science concepts. In this chapter the problem being studied is described in a statement of problem. Next, the conceptual and
theoretical framework is described. This is followed by a discussion of the purpose and significance of the study. Finally the research questions are outlined and key terms are defined.

**Statement of the Problem**

There has been ongoing concern about the quality of science education in the United States. Many research studies and reports suggest that schools continue to fail to adequately educate students in science. Despite many reform efforts and policy changes, US students’ performance in science seems to lag behind the performance of students from other countries (Gonzales et al., 2004; National Center for Education Statistics, 2011; National Commission on Excellence in Education, 1983; National Commission on Mathematics Science Teaching for the 21st Century, 2000; Rutherford & Ahlgren, 1990; Yager, 1991).

Children learn science in a social context by interacting with objects, materials, as well as with their peers and their teachers. Yet, few studies of science teaching and learning have examined socio-emotional factors. Although, it is well established that social interaction between children and their teacher is a critical factor for science learning (Dana & Davis, 1993; Duit & Confrey, 1996; Mercer & Littleton, 2007; Tobin, 1993), little is known about how social interaction influences children’s learning in science. Furthermore, how peer relationships and teacher student relationships influence interaction is unclear. It is therefore important to investigate the factors that affect and influence the social interaction and relationships that potentially stimulate or inhibit children’s learning in science.

As a complex system, the classroom consists of the teacher, the students, and teaching and learning acts between them. Each school day, teachers try to create desirable learning environments to achieve the highest student performance and interest in all subject areas, including science. But what type of teacher behaviors and interactions are preferable in creating
pleasing classroom environment that supports student learning? Different teachers may prefer different classroom environments which also affect their relationship with the students. Some teachers prefer a disciplined environment, whereas others prefer a more open, risk-taking, creative classroom environment (van Petegem, Creemers, Rossel, & Aelterman, 2005).

A teachers’ interpersonal behavior is very important for both classroom management (Doyle, 1986) and for establishing a warm learning environment. Teachers who create and maintain a positive relationship with students are more likely to utilize effective teaching strategies, and establishing necessary norms for successful classroom management (Hamre & Pianta, 2005). Positive teacher-student relationship is found to be essential for creating quality learning environments, and it is strongly related to student motivation and students’ academic outcomes (Birch & Ladd, 1997; Brekelmans, Wubbels, & Brok, 2002; Fraser, 1998; Fraser & Walberg, 2005; McRobbie & Fraser, 1993; Wubbels & Levy, 1993). Student interest and engagement in learning activities are also a result of healthy teacher-student relationships, which in turn affect student achievement and performance (Brekelmans et al., 2002; Wubbels & Levy, 1993).

Prior socio-psychological classroom environment research has shown that relationships exist between students’ academic achievement, motivation, academic engagement, and the classroom environment (Fraser, 1998, 2002; Fraser & Walberg, 1991). Students’ perceptions of the learning environment and their attitudes toward the subject being taught and their satisfaction with school are thought to be associated with educational effectiveness and student outcomes (Fraser, 1998, 2002; McRobbie & Fraser, 1993; Moos, 1979; Wubbels & Levy, 1993).

Interpersonal relationship of teacher and students can be determinants of the effectiveness of science education at the classroom level. Student enjoyment of science lessons has been found
to be associated with the interpersonal relationships developed between teacher and student, and their individual personalities (Creemers, 1994). Teacher student interactions and classroom talk may take place in quite different ways which may create opportunities for science learning (Brown & Hirst, 2007). However, little is known about how social interaction that is evident in constructivist classroom practices and teacher student relationships affect students' conceptual understanding of science and their willingness to engage in scientific activities. This study investigated features of social interaction and teacher-student relationships that create a constructivist learning environment where all students can fully participate and share their knowledge without any hesitation while improving their scientific understanding.

**Conceptual and Theoretical Framework**

Classroom environment and teacher-student relationship are essential for creating and maintaining a positive, supportive, warm classroom atmosphere conducive to learning (Williams & Burden, 1997). The nature of the relationship between teachers and students is closely related to classroom climate where support of a teacher offers undisputable opportunities for student learning (Moos, 1979).

According to the National Research Council (2007) student participation in science lessons help students improve their understanding of science process skills, enhance their use of scientific reasoning and interpretation, and create opportunities for constructing scientific knowledge. In order for students to participate fully in science classrooms and activities, they need to develop common understanding of ground rules for classroom participation. To establish such classroom rules and norms, students need to be actively involved in the development of these norms and be able to share their ideas, engage in debates, and arguments. Students’ critical thinking, skepticism, and desire to ask questions, and seek answers to those questions are
indispensable for successful participation in science classrooms (National Research Council, 2007). Active learning in general and student participation in particular involves students taking charge of their learning and taking responsibilities under the guidance of the teacher. In such constructivist classrooms teachers take on the role of a facilitator, share their power over the learning process with their students, and allow students to take responsibility for their learning while engaging in activities (Marlowe & Page, 1998; Mayer, 1998).

Interactions between teacher and student are important for student learning and understanding. As the teacher connects with the children’s existing cognitive structures, children gradually expand their learning experience (Watson, 1996). Therefore, students need to be given opportunities to initiate and participate in communications during classroom instruction. Such opportunities would allow students to initiate activities and be at the center of interaction during any student-centered instruction. Classroom interaction, which could be observed in the communications between teachers and students and in the communication of students themselves, has been identified as the major component of classroom activities and learning (Duffy, Warren, & Walsh, 2001; Lambert & McCombs, 1998; Mercer & Littleton, 2007; Watson, 1996). Regardless of whether the communication is initiated by the teacher or the students, or if it happens in small groups or the entire class, the teacher’s role in those interactions requires more attention. It is argued that advancement in cognitive abilities are likely to take place if children are active participants in the learning process and not passive recipients of knowledge delivered by others. Cognitive development occurs in the context of the child’s interaction with others and with the environment where active participation is encouraged (National Research Council, 2000, 2005, 2012).
Student-centered, goal-based, negotiated curriculum allows students to actively participate in the development of classroom rules, freedom of sharing ideas and questions. Such activities communicate a strong message of caring to students (Davenport, Jaeger, & Lauritzen, 1996; Tobin, 1993). Teachers bridge the connection between the students and the curriculum. Students’ perception of their teachers as supportive and caring has a direct effect on their perception of their school setting and willingness to participate in educational activities (Chesebro & McCroskey, 2002; McCroskey, 1992).

Social interaction in the classroom environment is shaped by the ways students and teachers talk to each other when engaged in classroom instruction and activities. Teaching itself requires teachers to use language and classroom talk to stimulate student interest and learning in general, and create opportunities for students to reflect on their understanding of the topics. From a socio-cultural perspective, teachers are considered as mediators who through talk, provide opportunities of collective classroom practices that are culturally and historically situated (Wertsch, 1998). Communication among learners and educators is seen as necessary part of learning from the view of socio-cultured theories. Social interaction and participation in social exchanges is necessary for internalization of learning (Rogoff, 1995; Wells, 1999, 2000) and students’ interests towards learning is strongly influenced by their teachers’ behaviors in the learning environment (Wubbels & Levy, 1993).

In a social setting the behaviors of individuals and the way they communicate mutually influence each other. In the classroom, behaviors and the ways the teacher communicates with the students influence students’ behaviors and their judgment of the classroom environment. Thus, a healthy communication process between teacher and student is essential for the creation
and maintenance of a good classroom environment and establishing quality interpersonal relationships (Wertsch, 1998; Wubbels & Levy, 1993).

The cognitive development of children, as well as their social competence and understanding is fundamentally related to their interaction with more knowledgeable people, including teachers. Teacher-student interaction is the focus for new learning in social constructivism and it is crucial for creating opportunities for children to become self-directed learners. The notion that novices become experts through appropriate interactions in educational context has its roots in Vygotsky’s writings. He believed that learners regulate their activity and learning under the guidance of a more capable adult or peer. The social support seems to help students become more competent and knowledgeable (Watson, 1996).

Social interaction in general and classroom interaction in particular has significant effects on children’s learning and cognitive development (Mercer & Littleton, 2007). Students come to the classroom with their own pre-existing knowledge and experiences. Constructivism requires each student to actively participate in the learning process. Students make decisions about their understanding of a construct by reflecting on their prior knowledge and experiences. The social interaction of students among themselves and with their teachers plays an important role in the creation of an environment that allows students to construct their own conceptual understanding (Yager, 1991). Therefore, from a constructivist perspective, what students know is constructed through their experiences of the natural world by means of their social interaction with others (von Glasersfeld, 1984). As students come to experience new information, their existing conceptual understanding is modified and revised to accommodate, understand, and make meaning of the newly introduced information (Driver & Bell, 1986; Driver & Erickson, 1983; Tobin, Kahle, & Fraser, 1990). Such construction of meaning is accomplished through active
involvement and experience, and it is an adaptive function rather than the discovery of absolute truth and reality (von Glasersfeld, 1984).

Students’ construction of personal knowledge is a result of their interaction with others (Driver & Oldham, 1986; Tobin et al., 1990; Yager, 1991). Although constructivism is not a teaching theory and supports learners taking responsibility for their learning (Driver & Bell, 1986), social interaction is at the center of the theory. Viewed this way the teachers are seen as the mediators and facilitators of student learning. In a constructivist classroom, teachers are expected to provide opportunities for their students to share their ideas and views both with the teacher and with their peers. Allowing student responses to drive lessons, and providing opportunities for student opinion about the content and instructional strategies to be used is necessary. Teachers are expected to seek elaboration from student responses to questions and encourage student inquiry by asking meaningful open-ended question. Encouraging students to ask questions and encouraging classroom discussion is essential for revealing student misconceptions of concepts and nurturing their natural curiosity. Teachers are expected to provide enough time for students to provide answers and make sense of any possible contradictions (Brooks & Brooks, 1999).

According to the constructivist view, students answering questions and generating their own questions reflecting the conceptual conflicts they experience might trigger the process of children seeking ways to resolve the conflict and become more interested in the topic (Tobin & Tippins, 1993). Thus, teachers can stimulate students’ thinking and learning by asking good questions. Expression of inquiry and desire for clarification of a controversy offer the possibility of students noticing their misunderstandings and allow them to learn from each other (McCartney, 1984). The circumstantial relationship between student utterances and teachers’
questions and feedback varies throughout classroom interactions. Depending on the context, teachers may exhibit different wait times for a given question or response and utilize more flexible listening and reacting patterns (Cazden, 2001). Such changes in pace may enable more students having enough time to evaluate the validity of their own ideas and benefiting more from the instruction (Minstrell, 1989).

Teaching is not about making someone understand but pointing them in the right direction, and guiding their thoughts where they can make connections of what they already know and what they experience as new. By drawing questions, making students and guiding the classroom discourse, a teacher can stimulate student thinking and press for understanding of the scientific phenomena. As each student comes to the classroom with different levels of knowledge and life experiences, revealing and tailoring those conceptions to the right path would require a certain level of one to one interaction with children. Asking children for different examples and having others comment on each other’s thoughts give teachers insights about the quality and quantity of students’ prior knowledge and experiences. In science, we want children to notice patterns, make relationships, identify causes and think of reasons and thus classroom talk is the mean for helping children focus their attention to right point and making mental connections (Newton, 2002).

According to Piaget, children’s active discovery of reality and constructing their own understanding are fundamental to their cognitive development. For Piaget, “what is learned is ultimately dependent on what children are able to assimilate into their emerging mental schemas, with all assimilation being a restructuring or a reinvention” (Mercer & Littleton, 2007, p. 9). From Piaget’s point of view, transmission of knowledge from adult to child is not accepted and interaction with adults are considered as irrelevant if not detrimental in children’s learning.
Piaget suggested that adult instruction and direct adult intervention to children's learning processes could inhibit their understanding and cognitive development as it limits children’s own exploration and interaction with their peers (Newman, Griffin, & Cole, 1989).

Both Piaget and Vygotsky believed in the important role of peer interaction in learning and development. But contrary to Piaget’s emphasis on peer interactions of children at similar cognitive developmental level, Vygotsky emphasized the importance of interactions between more and less knowledgeable individuals. For Vygotsky, social interaction, including the interaction with more advanced members of the society, is at the core of the developmental process. Children’s interactions with more knowledgeable others and with their peers are suggested to play an important role in learning and development (Mercer & Littleton, 2007).

**Purpose and Significance of the Study**

Learning is an active process in which learners construct their own understanding through making sense of their experiences and environment. Rather than passively absorbing knowledge, children learn while engaging in meaning making processes via social interaction (Airasian & Walsh, 1997; Driver & Bell, 1986; Pines & West, 1986; Simon & Schifter, 1991).

In today’s classrooms, students are expected to exchange their views and respond to what has been said by peers and teachers. Shifts between conversations with teachers and with peers may happen throughout the lesson and as teachers, students also take various roles during these interactions. The role of the student can be as simple as helping one another, or can be more complex and include tutoring others, critique other’s work, or collaborating in a group study. As students become more significant part of the learning environment, how teachers orchestrate
their students’ contributions to the lessons and the social relationships they establish gain more importance (Cazden, 2001).

Research on teacher-student interaction and classroom talk is important to understand how teacher-student interactions and relationships affect students’ academic success and their understanding of scientific concepts. Children’s interaction with adults and among themselves can provide important opportunities for learning and cognitive development (Mercer & Littleton, 2007).

Students can learn from their interactions as they negotiate their understanding while considering others’ ideas and get a chance to correct any possible misunderstandings (Edwards & Mercer, 1987). Classroom interaction may help children move forward in their conceptual understanding of all subject areas, including science. Teachers can stimulate this process by encouraging students for active participation and enable them to reflect upon and improve their understanding. Quality teacher-student interaction and healthy teacher-student relationship is necessary for effective classroom instruction and improved student learning. Teachers structuring questions to initiate thoughtful answers, using answers to provoke further questions and treating dialogues as building blocks for a shared understanding of ideas are all essential for student success and cognitive development. Orchestrated by the teacher, classroom talk and dialogic inquiry are effective when chained into coherent lines of enquiry and not left disconnected (Bakeman & Gottman, 1997).

Students can share their ideas and actively participate in classroom talk when teachers employ certain strategies in their instruction. Actively welcoming student ideas, following up on their remarks, asking effective questions with no predetermined answers, and providing feedback without evaluative comments attached to it encourages students to get involved in classroom
activities and prevent a monologic teacher talk in which students do not have any part (Nystrand, Wu, Gamoran, Zeiser, & Long, 2003).

The research on classroom interaction that is evident in classroom talk potentially provides valuable information. It is argued that such studies that look into the teacher student interactions and classroom talk yield the most valuable information as they depend on the recorded conversations and provide vital evidence for complex relationships (Edwards & Mercer, 1987; Edwards & Westgate, 1994).

Although, teacher-student interactions and teacher-student relationships have been topics of many research studies at the kindergarten level (Birch & Ladd, 1997, 1998; Bryant, Clifford, & Peisner, 1991; Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; Cohn, 1990; Pianta et al., 2005; Pianta, La Paro, Payne, Cox, & Bradley, 2002; Pianta & Nimetz, 1991; Pianta, Steinberg, & Rollins, 1995; Sroufe, 1983), much less is known about how teacher-student interactions and relationships affect students’ outcomes at the elementary school level, especially in science. Science education and our children’s success in science play a vital role in our nation’s future. Therefore, the relationship between teacher-student interactions, teacher-student relationships, and the conversations that take place during science learning activities in elementary school classrooms require more attention.

Examining teacher-student interaction and dialogue patterns during science instruction is necessary for determining factors affecting student learning in science. The results from the current study offer additional information for researchers to determine what specific interventions and support may be needed in teacher-student relationships and teacher-student interactions for enhancing students’ success and understanding in science. Following the suggestion that elementary school grades may be more of an importance for investigating
teacher-student relationships and resulting academic outcomes (Lynch & Cicchetti, 1997), the current study focused on the nature and quality of teacher-student interactions and its relationship to students’ science learning in elementary classrooms.

The current study sought to explore the nature and quality of teacher-student interactions in a third grade science classroom and investigated how interactions and teacher-child relationships relate to the learning of science concepts.

**Research Questions**

The study was guided by the following questions:

1. What is the nature and quality of teacher-child interactions during science lessons?

2. Is there a relationship between teacher-child interactions and teacher-child relationships?

3. Is there a relationship between teacher-child interactions and third-grade students’ conceptual understanding of science?

4. Is there a relationship between teacher-child relationships and third-grade students’ conceptual understanding of science?

**Definition of Terms**

Caring: The degree of teachers and students showing empathy, understanding, and responsiveness to each other’s feelings, problems or questions (McCroskey & Teven, 1999; Teven & Gorham, 1998; Teven & McCroskey, 1997). As Tarlow (1996) defines, it is the “supportive, affective and instrumental interchanges embedded in reciprocal relationships” (p. 81).
Classroom talk/discourse: In the context of this study, it refers to any talk that takes place in the classroom. The talk is often between the teacher and a student or group of students but talk between the students is also included.

Closeness: It is “a feature characterized by warmth and open communication… a source of emotional support and security for children as they (teachers and students) negotiate school demands” (Ladd, Birch, & Buhs, 1999, p. 1376).

Conflict: Set of inharmonious interactions between the teacher and the student that may evoke dissatisfaction, avoidance, withdrawal, or anger (Birch & Ladd, 1997; Jamieson & Thomas, 1974; Pianta, 2001).

Constructivism: Constructivism "is a theory about knowledge and learning… the theory defines knowledge as temporary, developmental, socially and culturally mediated, and thus, nonobjective" (Brooks & Brooks, 1999, p. vii).

Dependency: A child’s over-reliance on the support of the teacher (Birch & Ladd, 1997).

Dialogue: In the context of this study, the term represents teacher-student talk that takes place in the course of educational activities and search for understanding, empathy, approval or appreciation.

Scaffolding: Providing appropriate guidance and temporary support to assist student’s understanding. “Supporting a child’s thinking by structuring the process and guiding the child through it. The support is progressively reduced until the child can perform independently” (Newton, 2002, p. 172).

Supportive teacher-student relationship: A relationship that is built upon positive, caring and supportive social interactions.
Teacher-student interaction: In the context of this study, it refers to any contact that involves a verbal exchange between the teacher and the student.

Understanding: “The kind of learning that involves knowing purposes, structures, relationships and reasons” (Newton, 2002, p. 172).

Warmth: Teacher’s having positive feelings about the child (Pianta, 2001) and also refers to the student’s perception of such feelings.
CHAPTER 2

LITERATURE REVIEW

Overview

Rapid developments in science and technology require countries to seek ways to teach science well to their children in order to be competitive in global markets. Yet, there has been an ongoing concern for science education in the US. Many research studies and reports have indicated that we continue to fall short on educating our students adequately in science despite the efforts, policy changes, and reform movements (Gonzales et al., 2004; National Center for Education Statistics, 2011; National Commission on Excellence in Education, 1983; National Commission on Mathematics Science Teaching for the 21st Century, 2000; Rutherford & Ahlgren, 1990; Yager, 1991).

All children from all backgrounds have the intellectual and cognitive capacity to learn science when they come to school. Teachers play a critical role in promoting children’s curiosity and supporting their learning and advancement in science. Teachers need to create a learning environment that moves each child’s understanding of science and skills to a higher degree and provide support for children’s participation in scientific practices in the classroom. In classrooms, teachers and students spend a considerable amount of time interacting with each other, and a positive relationship between teachers and students is necessary for student advancement in cognitive abilities and affective learning outcomes (National Research Council, 2000, 2005, 2007, 2012).

This chapter provides a theoretical and empirical overview of literature concerning science education in the U.S, teacher student relationships and teacher student interactions as they relate to different student outcomes. The first section addresses the current status of science
education in the U.S., the leading philosophical frameworks used in science education, and the recommended science teaching practices. The second section reviews research that has investigated the effects of teacher student relationships and teacher student interactions on student outcomes. The nature and quality of teacher-student relationships and interactions, their direct and indirect effects on the classroom environment and classroom talk, and the role of gender in teacher-student interactions are some of the topics that are also discussed in this section.

**Science Education**

The necessity of strengthening science education in the U.S. has been a concern for the last decades and several reports and reform attempts sought to create a scientifically literate society (National Center for Education Statistics, 2011; National Commission on Excellence in Education, 1983; National Commission on Mathematics Science Teaching for the 21st Century, 2000; National Research Council, 2000, 2005, 2007, 2012). In 1983 the National Commission on Excellence in Education published their report, A Nation at Risk, and alarmed the nation by claiming that there was an immediate need for a better educational system. Adequately educated citizens and the workforce equipped with proper training and knowledge are thought to be essential for the U.S. to continue to be competitive in all areas within a global economy. The vital role of science in today's world required more attention to science education (National Commission on Excellence in Education, 1983).

In the midst of stunning advances in science and technology through the years, economic and industrial competition among the countries forced educators and policy makers to put more effort to developing better ways to educate their children in science. U.S. was not immune from the concerns of falling behind and in fact research studies and reports published since then

The National Research Council responded to such concerns and developed the National Science Education Standards envisioning scientific literacy for all students. The standards covered the areas of professional development, science teaching, science content, school and district programs, science education system, and assessment in science education. Several factors have been considered and used to develop nationwide acceptable and comprehensive standards for science education. Earlier reform efforts, research on science teaching and learning, exemplary teaching and learning practices created the foundation for the national science education standards and established the outline for what students need to know, understand, and be able to do in science at each grade level (National Research Council, 1996, 2005, 2012).

Policy makers supported the efforts of improving science education in the United States and No Child Left Behind legislation was introduced in 2001. NCLB aims to close the achievement gap between minority and disadvantaged students and their white counterparts. NCLB mandated all states to create their own standards for science education and state-level assessment tools in order to measure student progress in science by the 2006-2007 school year. In order to reach every school age children from all backgrounds school districts sought ways to place qualified teachers in every classroom. Here the aim was to ensure that all classrooms used standards based science instruction (Cavanagh, 2005; Hursh, 2007; Marx & Harris, 2006).

More than two decades after the report “A nation at Risk”, the National Research Council’s 2006 report, Taking Science to School: Learning and Teaching Science in Grades K-8,
analyzed and synthesized the research literature from several different disciplines and stated the following about the current status of science education in the US:

At no time in history has improving science education been more important than it is today. Major policy debates about such topics as cloning, the potential of alternative fuels, and the use of biometric information to fight terrorism require a scientifically informed citizenry as never before in the nation’s history. Yet after 15 years of focused standards-based reform, improvements in U.S. science education are modest at best, and comparisons show that U.S. students fare poorly in comparison with students in other countries...Thus, science education in the United States has become a subject of grave and pressing concern (National Research Council, 2007, pp. ES-1).

It is clear from the evidence that we are failing to capture the interest of our children in science (National Center for Education Statistics, 2011; National Commission on Mathematics Science Teaching for the 21st Century, 2000; National Research Council, 2007). It is also evident that other countries are outperforming the US in science education (Gonzales et al., 2004). The reports and literature on science education show that reform in science teaching and learning is a continuous process, and that searching for better ways to educate children in science is a never ending journey. Today, the challenges facing science education do not differ from those of the past. Clearly, the challenges coupled with the need for a scientifically literate society and well-trained workforce require a deep commitment to improving science education in U.S. schools.

As discussions continue on “what science to be taught” and “how science to be taught”, scientists and researchers agree upon the fact that the best way to learn science is to do science. Students learn better when they get beyond the dry facts and are given an opportunity to ask questions, conduct investigations, collect data, and generate their own answers to issues and problems via active participation. Student centered, inquiry based instruction where hands-on,
minds-on learning is encouraged and supported is at the core of good science education (Lind, 1997).

Science is considered as a process of inquiry rather than a set of mere facts (National Research Council, 1996, 2005, 2012) and teachers are expected to guide their students toward meaningful learning experiences which build upon students’ prior knowledge and experiences (Mercer & Littleton, 2007; Tobin, 1993; von Glasersfeld, 1984, 1993). When defining what science is Conderman and Woods (2008) state that:

Science is not just a body of facts to be memorized and then repeated on an exam, nor is it just a series of experiments to be performed in a laboratory. Science is a process-oriented, discovery- or inquiry- based approach to answering questions or solving problems. Science involves information about the natural and man-made world, and skills in discovering that information. In short, science is a way of knowing. (p.76)

While researchers and educators stress the importance of inquiry based active learning in science, elementary schools seem to be the weak link in science education (Conderman & Woods, 2008). The science taught in elementary classrooms is thought to be inadequate, and containing content that is often inaccurate and irrelevant to students’ lives (Aldridge, 1992; Driver, 1988; Tobin, 1990; Wenner, 1993). Many studies have found elementary school teachers short in their science instruction both in time devoted to teaching science and the content that is taught. A study by Weiss (1994) showed that less than a third of elementary teachers felt they were well qualified to teach science, and they spend only 27 minutes per day on average teaching science. The majority of elementary school teachers seem to be uncomfortable teaching science (Fulp, 2002; Weiss, 1987, 1994), and they often believe that science is less important than other subjects (Weiss, 1987).

Most elementary teachers either do not have adequate science background and content knowledge to teach science, or spend very little time teaching science. Only 4% of the
elementary teachers have a degree in science or science education and only a handful choose to participate in professional development activities regarding science and science teaching. Elementary teachers spend 4 times more time on either reading or literacy than they do on science, and they spend an average of 25 minutes per day on science activities. Approximately, 60% of elementary teachers still prefer to use traditional methods and whole class lecture to teach their science lessons (Fulp, 2002).

Improving science education in the United States is dependent on the ability of teachers to effectively teach science in the classrooms. Teachers should improve themselves on how children learn and start thinking beyond the traditional and objectivist paradigm. As a learning theory, constructivism is of particular importance in science education as it has too much to offer for teachers to understand how children construct their knowledge. Classrooms should not be considered as places to transfer knowledge from teachers’ to students but should allow for students’ active learning via social interactions. As an important part of constructivist perspective, student-student and student-teacher interactions in the classroom are key ingredients to create an efficient learning environment not only in science but in all disciplines (Liang & Gabel, 2005; Tobin & Tippins, 1993).

**Constructivism as a Theory**

Constructivism is a theory of learning that has influenced many disciplines from philosophy, and psychology to education during the last decades (Fensham et al., 1994; Tobin & Tippins, 1993). Tobin and Tippins (1993) define constructivism as “a way of thinking about knowing, a referent for building models for learning, teaching, and curriculum” (p.xv-4).

Constructivism has its roots in the theoretical works of scholars such as Dewey, Piaget, and Vygotsky. Constructivism is a theory of cognitive growth and learning that also has implications
for teaching (Forman, 1993; Müller, Sokol, & Overton, 1998; Walker & Lambert, 1995). From a theoretical point of view constructivism represents a different perspective from the traditional assumptions of "passive, teacher-dominated approaches emphasizing recall and regurgitation" (Crocco, 2001, p. 387). The constructivist theory views learning as a social process which involves one’s interaction with his/her environment and with others (Walker & Lambert, 1995).

Constructivist theories of knowledge are based on different assumptions from positivist theories. Constructivists believe that knowledge is constructed in the mind of the learner, therefore learners are expected to take responsibility for their learning as learning itself is considered as an active process (von Glasersfeld, 1984; Yager, 1991). In constructivism, learners individually construct their knowledge and prior knowledge and experiences of learners serve as a foundation for active construction of new knowledge. Constructivists argue that the construction of new knowledge is more of a match between prior knowledge, reality, and individual sense making (von Glasersfeld, 1984, 1993, 1995a). Furthermore, the mental processing involved in knowledge construction is not necessarily conscious but in fact much of the learning we do is subconscious. Thus, each learner’s interpretation of stimuli depends on his/her previously constructed learning and experiences (von Glasersfeld, 1995b).

Constructivists assert that knowledge is actively constructed and revised in human mind through continuing integration of new information to the old information. Knowledge results from individuals interactions with natural world and it is a constantly changing and evolving system of relationships between perceptions and propositions (von Glasersfeld, 1984). Children’s cognition develops through their encounters with new and different stimulating information which they can assimilate into their present understanding. Constructivism rightly stresses this essential relationship between new experiences and the ones already known. Individuals learn
and construct their own understanding as to the level which they can relate new experiences to their needs and interests. Meaningful effective interactions with others greatly enhance learning and understanding (Airasian & Walsh, 1997; Tobin & Tippins, 1993; Watson, 1996).

Piaget spent more than fifty years of his life researching the development of human understanding and the factors that influence cognitive development. His work influenced how researchers and educators view learning and knowledge construction and, thus, served as a foundation for constructivist philosophical framework (Henniger, 1999). As one of the most respected theorists of cognitive development, Piaget emphasized the importance of interactions between the child and the physical world. Children learn while they struggle to find solutions to the puzzles and paradoxes of the natural world. As children explore their environment and make sense of their experiences, their need for a physical experience to build mental representations lessens progressively. In time, children develop sophisticated mental representations of their environment and gain the ability to make sense of the world and how it works without needing to have experienced aspects of the world first handedly (Mercer & Littleton, 2007).

Like Piaget, Vygotsky was also interested in development of cognitive processes and viewed cognitive development as a constructive process. However, Vygotsky believed that construction of knowledge and understanding is a social activity rather than an individualistic sense making event predominantly based on the interactions between the learner and the physical world as claimed by Piaget (Mercer & Littleton, 2007). Vygotskian view of learning is a collaborative process and occurs in social and cultural contexts which allow students to enhance their performance beyond what they could achieve on their own (Vygotsky & Cole, 1978).

A child’s cognitive development is related to the support and guidance of more knowledgeable others, which Vygotsky conceptualizes as Zone of Proximal Development.
Vygotsky defines ZPD as “The distance between the actual developmental level as determined by independent problem solving and the level and potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (Vygotsky & Cole, 1978, p. 86). Children differ in their cognitive capabilities and understanding. What a child can accomplish against a task or problem without any help from others can reflect his/her cognitive capabilities. Support and guidance may help children improve their achievement and understanding and their cognitive capabilities which in the future may allow them to overcome problems without any help. The attainments that are possible with support and guidance are within that child’s ZPD. Progression through ZPD is takes place in four stages:

In the first stage, performance is directly assisted by more capable others through scaffolding of one kind or another. In the second, the learner effectively takes over the role of the scaffolder in relation to his or her own learning. This often means talking oneself through a task, remembering requests, reminders and injunctions previously given, and so on. The third stage is marked by the falling way of such self-guidance, as performance becomes automatic. The fourth stage just recognizes the fact that we can get thrown back to earlier stages of the acquisition process by such stressors as tiredness, or by changes in the precise conditions of the task (Mercer & Littleton, 2007, p. 17).

According to the constructivist view, teachers can facilitate cognitive growth by motivating and leading their learners toward meaningful learning experiences while preventing learners developing inappropriate ideas of a phenomena (Leinhardt, 1992; Shapiro, 1994; von Glasersfeld, 1993). Thus, in a truly constructivist teaching learning process, the principle is not restricted to the students, teachers are also considered as active learners. The teacher is learning about the students’ understandings and, in the process, reconstructing his or her own beliefs. Constructivists apply the principles of constructivism first to themselves in their activities and
continue to benefit and learn from their social interactions with others and with their students (Steier, 1995).

**Constructivism and Teaching Science**

Constructivism has been the leading philosophical framework in science education for the last thirty years. The constructivist perspective, in contrast to the traditional or objectivist paradigm, recognizes that science knowledge is not something that the teacher possesses and transfers to children. Learners actively constructing their knowledge which are derived from their experiences meaning making processes is at the core of constructivism (Tobin & Tippins, 1993). In short, constructivism describes how learners use cognitive processes to acquire and construct new knowledge (Airasian & Walsh, 1997).

Constructivism is considered as a learning theory but it also involves critically important implications for teaching as well. Teachers should have a solid understanding of constructivism and its explanations of learning processes in order to adopt and use the constructivist methods and strategies in their classrooms (Colburn, 2000).

According to constructivist view science knowledge is not a set of facts or information separate from knowers but a socially negotiated constantly changing phenomenon that attaches to other understandings and experiences (Driver & Erickson, 1983; Tobin & Tippins, 1993). In student centered science classrooms, student ideas evolve via students’ active engagement in discussions, debates, and negotiation processes (Duit & Confrey, 1996). Martin et al. (2001) state that “The constructivist teacher seeks ways to challenge and stimulate mental connection-making in order to enhance the active participation of learners in lessons and encourage learners to construct their own understanding from their sense of reality, which arises from their experiences” (p. 121). From the viewpoint of constructivist learning theory, teacher guidance is
necessary for learners to alter their own beliefs with those held by the scientists. Therefore, the purpose of teaching and classroom talk is to help students understand how their explanation of concepts is different from the scientifically accepted ones and why their explanations would fail to explain and predict a given scientific phenomena (Colburn, 2000). For example, children observing an experiment on floating objects may not necessarily make the correct inferences. A small blue floating metal tube, and a big blue floating wood piece versus sinking triangle shape big metal piece or a small soaking rock piece would require students to decide if color, size shape, density, or solidity or etc. matters the most. This requires students to interact with each other and to construct their own meaning and understanding. Classroom discussions and teacher talk can gently lead students’ attention to the right path and help them gain new perspectives when they seem to get lost. In addition, some students may feel insecure when sharing their thoughts due to fear of failure and humiliation. Or, they may simply be shy or less confident of their skills. Therefore, science talk should be rewarding, considerate and allow variation among students in order to increase student curiosity and desire to learn science (Newton, 2002).

In constructivist classrooms, teachers do not simply present the new information to the students but are expected to correct students’ misconceptions while guiding them through the activities. Thus, teachers have the responsibility of what students bring to the classroom, these are, their prior knowledge and beliefs (Shapiro, 1994). Teachers are facilitators of students’ personal and social meaning construction processes.

In a constructivist science classroom, the teacher is a facilitator of students’ personal and social construction processes. The teacher is responsible for creating a friendly classroom environment where students experience the joy of participating in activities, discussions, and figuring out solutions to the problems. Classroom interaction is used to promote learning in a
cultural context. Teaching and learning roles are characterized by negotiation rather than imposition. Teacher and the students together find solutions to problems and reach to a conceptual understanding through classroom interaction. There is not a prescribed method for teachers to apply in order to achieve the lesson’s objectives (Cobb, 1988). Teachers’ main responsibility is to motivate and encourage students to seek answers to the problems, and work toward understanding new concepts (von Glasersfeld, 1993).

Listening to students’ voices is an important part of teaching. Students share their ideas and reflect on their learning only if others listen and respond. Paying attention to student ideas and making effort to understand the sense they are making maximizes student learning. However, creating a quality learning environment where students and the teacher share ideas and communicate effectively is also a challenging complex task for teachers. Teachers should provide enough time and support for students making connections between new experiences and the old ones. Orchestrating the classroom talk effectively is essential to create a community of learners where both students and the teacher responsibly share their ideas and thoughts (Cazden, 2001).

Students are at the center of learning process in constructivist learning. Classroom activities that allow students to engage in problem solving tasks as individuals or in small groups are critical for knowledge construction. Classroom activities provide an opportunity for teachers to discover their students’ misconceptions. Students also get a chance to revise their prior beliefs while participating in classroom discussions. During hands on activities, students engage in thinking about unexpected outcomes and develop answers to problems. Activities which are designed to arouse students’ curiosity are used to teach scientific knowledge to students as a natural process (Brooks & Brooks, 1999; Zahorik, 1997).
As teachers and scientists do, students construct science knowledge to make sense of their interactions with their world and with other learners (Dana & Davis, 1993). Hands on activities are very important for knowledge construction in a constructivist science classroom. During hands on activities, learners get a chance to utilize their skills such as hypothesizing, predicting, investigating, developing questions, and searching for answers. Through the process of exploration, concept introduction, and application, students are able to reveal their understandings. With the support of discussions about their conceptions with their peers and others, they may be able to construct patterns and relationships (Fosnot, 2005).

Children may see a scientific event as we see but it does not necessarily mean they will associate the correct meaning to it or understand the scientific phenomena behind it. The mental connections we want children to make are not always clear or simple enough to grasp immediately. They might be misinterpreted and wrongly constructed in children’ minds. Classroom talk can support healthy understanding and gives the teacher the means to intervene any misunderstanding and monitor the quality of learning. For example, a child may hold a belief that water comes from the walls without the consideration of pipes hidden in the wall. Similarly, in the child’s mind, the moon could be as small as he/she sees it up in the sky or may have air or atmosphere. Talking to children and providing them with the means to express themselves through discussions and peer talk provides an opportunity for teachers to determine and correct such misconceptions (Newton, 2002).

Group work and interaction is very important for active learning in constructivist classrooms. Students are able to negotiate the differences in their opinions and reach agreement during group interactions (Linn & Burbules, 1993; Tobin & Tippins, 1993). Thus, the constructivist science classroom is “a social arena for the public examination of ideas… students
naturally build on or refute old ideas as they are merged with knowledge” (Leinhardt, 1992, p. 24). In constructivist view, each student has a unique understanding of ideas and concepts and the level of understanding may be different for each child. Students sharing ideas with others in the classroom help them to clarify their own understanding and see how others think on the same issue. When students work in groups, they become interested in their classmates’ ideas and tend to listen and discuss more openly as they share ideas and reflect on each other’s views. If they experience new ideas and approaches, they match them with their own ideas and see the constraints. This may lead to accommodation which is building up a new model of understanding (Shapiro, 1994; Slavin, 1991, 1995; von Glasersfeld, 1995b). Teacher’s awareness of a child’s understanding and misconceptions is one of the most essential elements of classroom interaction. Teachers need to support students to make connections between their current and past experiences. As students get more experienced in establishing such connections, they will begin to generalize their understanding to different disciplines and topics with minimal effort to it (Watson, 1996).

In the constructivist approach the teacher’s primary task is to help students to see the links between concepts and learn them by experience. The teacher uses lecturing to foster new combinations of concepts. By talking, the teacher cannot transfer the concepts to the student’s mind but can propose combinations that students may not have thought of by themselves or had no occasion to use before in their lives (von Glasersfeld, 1993). In a constructivist science classroom, students learn by using their senses and manipulating objects rather than just listening to the teacher or reading from the textbook. Textbooks are part of the constructivist classroom in terms of introducing and fostering new ideas but they are not something to be relied on for meaningful learning. Reading helps students construct their own understanding of new concepts.
but words alone do not carry meaning unless students make sense of the ideas behind the text (Yager, 1991). Research suggests that there are academic benefits associated with better student ratios where more opportunities for feedback, time for active learning and individual assistance are available (Greenwood, Carta, & Kamps, 1990). Children also learn better when they engage in activities where they can interact with their peers and in cooperative learning environments where they can learn from each other’s mistakes, support each other, and interdependent on each other in a positive way (Johnson & Johnson, 1989; Slavin, 1991, 1995).

Teachers asking students about how they arrived at a given answers is important so that they can understand children’s reasoning. This way the teacher can provide feedback regarding the students’ answers, why it is wrong or right, and help students to revise their answers (von Glasersfeld, 1995a). Questioning is a natural and necessary part of classroom talk and teachers can ask lots of questions. On the other hand, why, when, and how teachers use questions can significantly impact their students' understanding. Teachers using questions to unearth students' prior knowledge, to facilitate higher order thinking processes, to guide them thorough activities while monitoring their engagement and to assess their cognitive development and understanding, are more likely to accomplish better student outcomes and learning. Successful teachers are their students' intellectual guides, who help children to understand and appreciate the purpose of classroom activities and their meaningful connectedness from one topic to another. Questions should be used to elicit reasoning behind answers rather than an intention to evaluate what students did or know (Mercer & Littleton, 2007). Thus, teachers should provide enough time for students to respond to questions. Appropriate wait time is essential since a rapid response can curtail children’ thought whereas a long wait may cause them loose their interest and look for another entertainment. Explanations can take time to construct and continue to develop as a child
talks. Therefore, waiting a couple of seconds after a student’s response not only allows the child to extend his/her explanation, but also allows other students determine the correct response and add to it. In short, for thoughtful responses children need time to think, construct, and reflect on their understanding (Newton, 2002). The quality of teacher-student interactions are improved when teachers give at least three seconds or more for students to reply (Cazden, 2001; Tobin, 1987). Students provide more varied and comprehensive responses in classrooms where teachers ask fewer but more complex questions (Cazden, 2001).

Constructivist science teachers are eager to use different science materials such as additional books, computer software, videotapes and so on to enhance learning. They are flexible in classroom management and time use because students needs time and positive atmosphere to explore, think, discuss and ask questions. Students and teachers investigate together and share many responsibilities that are carried only by the teacher in traditional classrooms. Successful teachers use effective questioning strategies. Students benefit from the questions which best assist them to access and uncover the information. Different types of questions allow teachers to reach different students and different student experiences. Students are also encouraged to prepare and ask questions in constructivist classrooms. The goal is to encourage students to develop questions that will allow them to achieve a maximum amount of insight and information through the types of questions they ask. Such an approach enables students to meaningfully question themselves and others (Martin et al., 2001; Shapiro, 1994). Thus, von Glasersfeld (1995b) states that “when students are driven by their own interest to investigate and conceptually grasp a situation, the conceptual changes they making during the process of reflection will be far more solid than if they were imposed by teacher” (p. 188)
Any dialogue including asking questions, making comments and classroom talk as a whole can only be accomplished by the collaborative work of teacher and students. Yet, the quality of the conversations depend more on the communicative competence of the students which develop gradually develops over years through education and practice. Teachers play a dual role in these conversations as they are both the participants and the directors of the classroom discourse but they also need to provide opportunities for all students to practice and improve their ability to express themselves (Cazden, 2001). Constructivists emphasize the important role of classroom discussions in student learning. Through the classroom interaction with peers and the teachers, students may witness each other’s ideas, clarify their understanding of concepts, identify and resolve problems, raise new questions about their own and other’s understanding (Tobin & Tippins, 1993).

In constructivism, social interaction is fundamental to learning (Vygotsky & Cole, 1978). Social interaction involves dialogue whether it is between learners at similar level of understanding or between learners and more knowledgeable others including teachers. As children can actively construct their own understanding, they are also dependent on dialogues with knowledgeable others who can provide effective scaffolding (Mercer & Littleton, 2007). The adults’ temporary support and guidance for children achieving a new level of understanding through different supportive ways such as encouragement, focusing, demonstrations, reminders, and suggestions is referred as scaffolding. The metaphor, scaffolding, is a type of support that helps learners overcome a problem which they wouldn’t have been able to do on their own. For Vygotsky, assisted learning and scaffolding enable learners to improve self-supported competence and achieve understanding. Thus, as stated by, “The development of understanding is seen as a process of guided re-invention, whereby social guidance makes it possible for the
learner to achieve a constructive intellectual re-invention of some piece of culturally elaborated knowledge” (p. 17).

Cognitive development and learning of students are enhanced during social interactions and scaffolding. Teacher talk enables students to advance their intellectual capacity and improve their understanding (Fosnot, 2005; Watson, 1996). In constructivist classrooms, the teacher is the facilitator of ideas and expected to create a learning environment open to inquiry. Thus, teachers should utilize scaffolding in order to help learners extend their zone of proximal development and reach higher levels of understanding (Barron et al., 1998; Collins, Brown, & Newman, 1989). Providing children supportive and appropriate levels of assistance when needed is essential for scaffolding and student learning. Simplifying and pointing out discrepancies while maintaining student interest and engagement are necessary for students’ knowledge construction. If correctly implemented in the classroom, scaffolding will result in improved student understanding and comprehension (Palincsar, 1986; Watson, 1996).

Repeated skilled experiences of scaffolding result in students improving their independent learning abilities and awareness of their own learning. Such experiences also encourage students to believe in their thinking and problem solving abilities while keeping their confidence high against challenges (Watson, 1996). Research findings of Watson (1996) suggest that student enjoyment is enhanced in classrooms where teacher expectations are high and demanding. Students, who are engaged in practicing skills such as worksheet, appeared frustrated and bored even at times where individual one to one teaching is available. Students’ enthusiasm significantly increased when participating in cognitively demanding tasks. Thus, whether the teacher had demanding expectations or not, some students may get emotionally upset against obstacles. Working together in groups and engaging in activities may not be easy
for all students as learning itself is not an easy task and has many dimensions to it. However, Watson’s research showed that students of teachers with greater expectations and demands, often showed a more improved sense of engagement, interest, and achievement.

Constructivist teachers are expected to avoid making judgments of their students’ understanding of a particular concept when they express their views (von Glasersfeld, 1995b). Sometimes the gap between what the children know and what we want them to learn may be large. The nature of conversations and teachers’ use of language is important for narrowing and eventually closing this gap (Newton, 2002). In Vygotskian theory of learning, the gap between what people are able to do themselves and what they can do under optimum assistance is defined as “zone of proximal development” (ZPD). Children’ understanding can be advanced by proper guidance and teachers can enable learners having difficulty advance their understanding and go beyond the “zone” (Watson, 1996, p. 6). Science conversations should be open and non-judgmental in order to encourage students share their understanding without a fear of being wrong. Flexible and unhurried instruction where each student has a voice and something to add is more likely to increase student contribution to the lesson. Students would engage in activities that interest them more than others. However, teachers can use their enthusiasm to draw attention to the most boring topics and encourage all students to reveal, adjust and extend their understanding (Newton, 2002).

According to the constructivist view, teacher observations should seek to understand their students’ beliefs, and teachers should develop a positive attitude toward student responses. Openness and will to hear students’ ideas is essential for teachers developing strategies to help student alter their understanding. By using this strategy, the teacher encourages students to take risks and develop their own ideas without feeling the fear of being incorrect. Teachers should
create a classroom atmosphere where students can share their ideas freely and be conductive (von Glasersfeld, 1995b). Science teachers use student comments and responses not only to evaluate student understanding but also to initiate discussions and to provide feedback to student responses and inferences that may hinder misconceptions. Drawing out the significance of students’ work, responses, and feedback can positively reinforce student learning (Cazden, 2001).

In constructivist classrooms, assessment is not considered separate or distinct from the instruction itself. Teachers consider assessment as a natural part of classroom instruction and embed into the activities. In addition to informal assessment tools such as observation of student participation and contributions, teachers may also rely on written assignments or portfolios. Performance assessments and observations are a daily part of classroom instruction and necessary tools for assessing student progress (Brooks & Brooks, 1999).

In sum, social interaction is at the core of constructivist theory. The theory gains more importance for those researchers’ investigating teacher-student interactions and student learning during the lessons. Constructivists view learning as an active process which learners construct their own understanding in a social context (Colburn, 2000; von Glasersfeld, 1984, 1993, 1995b). Students’ interactions and relationships with their peers and teachers in the classroom play an important role in their knowledge construction (Yager, 1991). Thus, teachers’ are expected to create an open learning environment where they can freely share their ideas with their classmates. Positive teacher-student relationships are critical for drawing students’ attention to their learning and increasing their motivation in the learning environment (Cobb, 1988; von Glasersfeld, 1993). Positive teacher-student relationships and the interactions may provide the
stimuli for the students to move forward in their learning and cognitive development (Alexander, 2011).

**Teacher-Student Relationships**

Children’s learning and intellectual functioning in the classroom and outside is strongly related to the social interaction and relationships in which they are embedded (Cazden, 2001). Teacher-student relationship and the quality of interactions between them are strongly related to children’s social, emotional, and cognitive development (Birch & Ladd, 1998; Hamre & Pianta, 2001).

Young children constantly observe the world around them and seek answers to the problems. As do parents, elementary school teachers play a critical role in promoting children’s curiosity and supporting their learning and advancement in critical thinking. A rich and engaging elementary science experience can build upon student's prior knowledge, and inquiry based instruction can stimulate student curiosity toward learning science. Each child comes to the classroom with a set of ideas and experiences which vary depending on their age, skills, knowledge, and conceptual development. A teacher is responsible for evaluating students’ progress and creating a learning environment that is suitable for student’s development and experience level (National Research Council, 2007).

Quality teacher-student relationship is essential for teachers to be able to determine their students’ prior knowledge, experiences, and possible misunderstandings in science. One of the main goals of education is to establish positive teacher-student relationship. The research literature on teacher-student relationships consistently suggested that positive, caring, and quality relationship bring about improved student outcomes (Fraser & Walberg, 2005). Similarly, students with positive views of their teacher and relationships experience fewer problems and
outperform their peers at school. Students who experience more problems at school tend to have negative views of their teacher and consider their relationship with their teacher considerably weak (Crosnoe, Johnson, & Elder, 2004). There is no question that teacher-student relationships vary depending on the quality of the relationships and factors affecting the nature of the relationships such as its being close or conflictual, secure or unsecure, positive or negative, formal or informal, affectionate or distant or etc. (Birch & Ladd, 1998; Elicker & Fortner-Wood, 1995; Pianta et al., 1995).

Teachers are expected to establish positive relationships with their students as it is essential for students adjusting to school in early grades (Birch & Ladd, 1997; Lynch & Cicchetti, 1997; Pianta & Nimetz, 1991). Young children’s interactions with non-parental adults determine the quality of their experiences and their adjustment to schooling (Kontos, 1999). Behavior orientation and school adaptation of young children as early as kindergarten through first grade strongly depends on the quality of the relationship between the child and the teacher. Aggressive behaviors with peers and adaptation problems are more likely to occur when the relationship between the teacher and the child is negative and conflicted (Birch & Ladd, 1998; Pianta & Nimetz, 1991). The early school experiences of young children are especially important as being the determinants of children’s future relationships with their teachers and with their peers (Birch & Ladd, 1998; Howes & Hamilton, 1993). Children who fail to establish strong and positive relationship with their teacher tend to demonstrate higher levels of behavior problems (Pianta et al., 1995), and show limited engagement in classroom activities (Ladd et al., 1999). On the other hand, students who have positive and secure relationship with their teacher demonstrate better engagement to classroom activities, and seek for opportunities for learning (Elicker & Fortner-Wood, 1995).
Student’s academic outcomes (Birch & Ladd, 1997) and their social affiliation with school strongly depend on the support they are getting from their teachers (Birch & Ladd, 1997; Wentzel, 2002). The study conducted by Baker (1999) looked into the teacher-student interactions and relationship quality in urban at-risk classrooms through third to fifth grade. The results of the study suggested that a positive learning environment fostered by teacher support helps students establish stronger attachments with school. Student’s positive or negative perceptions of the school and their experiences with their teachers have a great impact on their school satisfaction. Students with better relationships with their teachers and received more support from their teachers expressed more satisfaction with school. Student perception of their relationships with their teachers and positive classroom climate are found to be determinants of students stating their school environment as satisfactory or not satisfactory. As early as third grade, caring and supporting relationships with teachers affect student’s affiliation with their school and perception of their school experience as more caring and supportive (Baker, 1999).

Teachers constantly look for methods and strategies to increase their students' engagement in their learning. Research supports the notion that students' active contribution to the classroom activities and their participation in challenging tasks promote deeper understanding of concepts and result in better academic outcomes (Fosnot, 2005; Kreber & Cranton, 2000; Marlowe & Page, 1998). Thus, children’s experiences in school and their social adjustment to the classroom are influenced by teachers. Teachers are not only responsible for teaching the curriculum, but also have the responsibility of setting the guidelines for student participation, classroom activities, and the level of interaction between students (Howes & Hamilton, 1993; Pianta, 1997). Students give great value to their teachers’ emotional and instructional support. Simpson and Ure (1994) suggest that students value quality of their
interactions with the teacher as the most important factor for their learning. Teachers’ expressing interest to student difficulties and presenting a non-judgmental approach to their queries found to be significant factors in their assessment.

There is enough evidence that quality teacher-student relationships resulting from warm and supportive teacher-student interactions contribute to better academic performance and achievement gains (e.g., Hamre & Pianta, 2001; Pianta & Stuhlman, 2004; Skinner, Connell, & Zimmer-Gembeck, 1998). Students who have a pleasant and caring relationship with their teachers tend to put more effort toward meeting their teacher’s expectations. Likewise, student motivation toward having a better relationship with their teacher and their acceptance of classroom rules improve as the quality of the relationship increases (Furrer & Skinner, 2003; Gest, Welsh, & Domitrovich, 2005; Wentzel, 1998).

**Teacher-Student Interactions**

It is widely accepted that students accomplish better learning outcomes in student-centered learning environments where students can actively participate and are allowed to adopt their knowledge to new problems and concepts. This requires teachers to be aware of their students' individual knowledge level, experiences, background and their needs in order them to be able to considering and adopting necessary pedagogic and instructional strategies for deeper student understanding (Lambert & McCombs, 1998; Land & Hannafin, 2000; McCombs & Whisler, 1997). Positive teacher-student interactions and classroom talk provide opportunities for teachers to learn more about their students and in return by facilitating positive and supportive classroom interactions, teachers’ may help their students to accomplish better academic outcomes (Fosnot, 2005; Lambert & McCombs, 1998).
Interaction is a fundamental process for learning that takes place between the learner and the learning environment, in which the learner actively engage with various media the environment (Moore, 1989; Vrasidas, 2000; Vygotsky & Cole, 1978). Simpson and Galbo (1986) assert that the primary characteristic of interaction “is reciprocity in actions and responses in an infinite variety of relationships: verbal and nonverbal, conscious and nonconscious, enduring and casual. Interaction is seen as a continually emerging process, as communication in its most inclusive sense” (p. 38). Vygotsky proposes that social interaction has a fundamental role in children’s learning and cognitive development. Vygotsky developed the idea of Zone of Proximal Development (ZPD) which means that children master new skills and learn new information as they interact more knowledgeable others. Mercer and Littleton (2007) explain the Vygotskian view of cognitive development as “a kind of apprenticeship served by the child under the tutelage of adults whereby these cultural tools [artifacts, technologies, language, rituals] become part and parcel of the child’s own mental resources; a process of internalizing the knowledge gained” (p.13).

There is no objection that children begin to interact with the objects and people in their environment since the day they open their eyes to this world. Cognitive development and learning of children are enhanced during those social interactions with their parents and other adults around them (Watson, 1996). In the early years of life, parents’ interaction with their children provides invaluable opportunities for children’s learning and has strong effects on their cognitive and language development. According to Robinson (1986), children with mothers providing explicit answers and details to queries, asking for clarifications and why questions along with an effort to scaffolding child’s thinking, develop relatively advanced communication skills and a reasoning to adjust their conversation depending on the listeners needs.
There is a growing interest in teacher-student interactions and classroom discourse in the educational community. The way the teachers’ interact with their students and the conversations that take place in the classroom have been found to have an impact on students’ cognitive development, conceptual change, and skill development along with positive changes in their use of inquiry and development of ideas in science (e.g., Cazden, 2001; Driver, Newton, & Osborne, 2000; Fosnot, 2005; Mercer & Littleton, 2007; van Zee & Minstrell, 1997; Watson, 1996). Students’ academic outcomes and their achievement levels tend improve when they can establish healthy and quality interactions with their teachers (Hamre & Pianta, 2001; Pianta & Stuhlman, 2004; Skinner et al., 1998).

In an effort to describe teachers' role in classroom interactions, Mercer and Littleton (2007) describe 'dialogic teaching' as that is in which:

- students are given opportunities and encouragement to question, state points of view, and comment on ideas and issues that arise in lessons;
- the teacher engages discussions with students which explore and support the development of their understanding of content;
- the teacher takes students' contributions into account in developing the subject theme of the lesson and devising activities that enable students to pursue their understanding themselves, through talk and other activity;
- the teacher uses talk to provide a cumulative, continuing contextual frame to enable students' involvement with the new knowledge they are encountering (p.42).

The National Science Education Standards have identified the pathways to a scientifically literate society. All students regardless of their age, race, gender or cultural background should
have the opportunity to learn and understand science. Actively engaging in scientific inquiry not only allows students to understand the natural events and phenomena that take place daily around them, but also allow them to use their scientific knowledge in their everyday life (National Research Council, 1996, 2012). As outlined in the standards, understanding science is important for all students, and later legislative efforts like No Child Left Behind act aims to close the achievement gap between students of different backgrounds. However, do we really treat our children equally and how does it reflect itself in classroom interactions in terms of gender and race?

**Gender and Race in Teacher-Student Interactions**

Research supports the notion that teacher interactions may differ from one student to another. Although research studies report inconsistent information on the effect of gender in teacher-student interactions, some research indicates that teachers interact more with boys than they do with girls, especially in some disciplines like mathematics. Thus, teachers have a tendency to initiate more contacts with boys as opposed girls, and they call on boys more often to answer questions (e.g., Brophy & Good, 1974; Good, Sikes, & Brophy, 1973). Furthermore, the match between the ethnicity of the teacher and the student may lead to more positive relationships in some classrooms (Saft & Pianta, 2001).

Teachers tend to call students with lower ability less and provide fewer opportunities for them to interact. Lower ability students usually don’t get the same opportunity as their more able peers in order to answer teacher questions. They are given less time to respond to questions and they are provided limited feedback (Wang, 1991; Wood, 1992). For all students with different ability levels, the quality of teacher-student interactions improve when teachers give at least three seconds or more for students to reply. Thus, students provide more varied and
comprehensive responses in classrooms where teachers ask fewer but more complex questions and provide more time to generate their responses (Cazden, 2001). Teachers often interact in a more controlling tone with the less able students. Conversations are mostly built around teacher questions and rapid corrections. This causes lower ability students to initiate conversations less and create hesitation for them to participate and contribute to classroom discussions (Wang, 1991; Wood, 1992). Rowe (1974b) reported that lower ability students are given less wait time to answer questions than their higher ability peers. Science achievement of students proved to improve when teachers provide longer wait time for student responses (Tobin, 1980; Tobin & Capie, 1982).

Several studies have also investigated gender, race, and students outcomes and how they relate to the differences in teacher-student interactions. Different methods have been employed to analyze teacher student interactions such as the wait-time analysis approach as exampled in studies of Rowe’s (1974a, 1974b) and the investigation of teacher-student dyadic interactions based upon the work of Brophy and Good (1969). The knowledge accumulated through these studies supports the notion that teachers tend to interact differently depending on the gender of the child.

In their analysis of teacher-student interactions in science classrooms, Skolnick, Langbort, and Day (1982) reported that teachers favor their male students over female students in their teaching practices. Male students were given more attention and received high level questions more frequently than the female students. Teachers also asked fewer questions and paid much less attention to their female student’s answers compared to boys. The amount of time given to answer the questions and the amount of praise provided for correct answers were also significantly less for the girls. Girls were often interrupted while sharing their ideas and called on
less often by their name compared to boys. Other studies also reported that at the elementary school level boys typically receive more encouragement to complete the tasks and projects on their own than do girls. Boys are given specific instructions in order to complete a task, whereas girls are either shown how to do the task or simply teachers prefer to complete the projects for them. Moreover, teachers are more likely to call out boys in classroom activities and praise boys more often for their intellectual ability to produce a quality work. Girls receive more praise for their neatness rather than their intellectual work. During classroom activities, boys are less likely to get interrupted in their contributions and given more time to express themselves. On the other hand, girls tend to establish more supportive ties and close relationship with their teacher than boys do during the early years of schooling (Birch & Ladd, 1997; Dweck, Davidson, Nelson, & Enna, 1978; Hall & Sandler, 1982; Taylor & Machida, 1996).

Boys are more likely to experience conflict in their relationships with their teachers (e.g., Birch & Ladd, 1997, 1998; Hamre & Pianta, 2001; Kesner, 2000; Stuhlman & Pianta, 2002) and their misbehavior is taken more seriously than that of girls (Borg & Falzon, 1993).

Hamre and Pianta (2001) investigated the early school adjustment and later academic and behavioral performance of kindergarten students through eighth grade as they relate to their teachers’ perceptions. A sample of 179 children from kindergarten through eighth grade were the subjects of study. Results revealed that kindergarten teachers experienced more conflictual and distant relationships with boys than with girls. High conflict and dependency were found to be the sign of poor academic success for boys but not for girls throughout elementary and middle grades. Students who had a conflictual relationship with their kindergarten teachers, regardless of their gender, developed more negative work habits and experienced more disciplinary problems during higher elementary grades. However, positive work habits in lower grades indicated closer
relationships with their kindergarten teachers for girls. Thus, fewer disciplinary problems were reported for girls who had a closer relationship with their kindergarten teachers in the upper elementary grades.

During the last decade, closing the achievement gap among students, especially students of different social and ethnic backgrounds also became a national priority (Cazden, 2001). Studies looking into race as a factor in teacher-student interactions provide support for an assertion that white students are given more attention compared to their African American peers and they are more likely to receive praise during classroom activities (Hillman & Davenport, 1978; Marcus, Gross, & Seefeldt, 1991; Weinberg, 1983).

Casteel (1998) examined the teacher-student interactions and differences in teacher treatment between African American and Caucasian students in middle school students. 417 students and 16 Caucasian teachers from 8 different schools participated in the study. Each teacher’s classroom is observed for a period of 2 hours by using the coding techniques in Brophy-Good Dyadic Interaction System. Results of the study suggested that race is a significant factor in teacher-student interactions. African American students experienced more negative interactions and received significantly less praise from their teachers than their Caucasian classmates. Teachers gave more clues to Caucasian students when answering questions and provided more positive feedback. In regards to gender, boys were called on more frequently than girls in general and teachers praised boys over girls more often. Among boys, African American boys received less praise than all other students and they initiated less interaction with their teachers. On the other hand, Caucasian boys attempted to answer more teacher questions by raising hands and in return received more guidance from their teachers. Teachers also directed
more process questions toward Caucasian students and called them directly by their name more frequently than African American students.

**Classroom Talk**

The basic purpose of education and schooling can only be achieved through communication between administrators, teachers, and students (Cazden, 2001). Talk is a powerful way of supporting student understanding in science. Through talk, teachers can foster student learning and help children make sense of their own thoughts (Newton, 2002). In that sense, spoken language is the medium in classrooms that allows teachers to present new information and students to demonstrate their learning. Teachers are responsible for orchestrating classroom conversations as to enhance student learning and prevent simultaneous conversations which may impair effective teaching environment (Cazden, 2001).

Providing opportunities for students to explore and express their thoughts through talk increases the likelihood of students developing a well-founded scientific understanding. However, initiating and orchestrating classroom talk in science classrooms is not always as easy as in some other disciplines since leading students toward what matters more among all other things in an activity can be a real challenge for the science teacher (Newton, 2002).

Children’s ability to use language as a learning tool may vary from one to another (Mercer & Littleton, 2007). The amount and quality of the talk children experience at home has an effect on their school success and those students with better experiences are more likely to present better academic achievement at school (Hart & Risley, 1995). Therefore, teachers providing similar opportunities for all, including the ones who lack the experiences of language use for learning, investigating, and reasoning, is essential for children’s improving their skills in problem solving and their science achievement (Mercer & Littleton, 2007). Some students may
get confused or feel anxious or rebellious at times when teachers are vague in their dialogue with children. They may comply to the best of their ability by remaining silent or rebellious. But neither of those cases is desirable for an effective learning environment (Mooney, 2005). Thus, children need intentional efforts of teachers guiding them towards advanced communication skills. Research on young children’ language development suggests that quality child care environment and the amount of verbal interaction between children and adults, not only affect children’ language skills but also affect their cognitive development in a positive way. Verbal interactions aiming for higher order thinking, reasoning and information sharing have significant effects on children’ cognitive and language development (McCartney, 1984).

Vygotsky proposed that language is the principal tool for building knowledge. Children’s intellectual development and learning is shaped by their communication skills and their capability of using language as a mean to interact with others. Language and communication are the tools to reach agreements, develop solutions to problems, and establish a shared understanding. Through social interaction, information sharing, and cooperative work, children can add new information to their knowledge base and find creative ways to overcome problems. Children’s collaborative learning and their success in information sharing processes strongly relates to the educational dialogues that they are involved in and the quality of the classroom discourse (Mercer & Littleton, 2007).

Communicating science to children requires consideration and support since scientific language includes abstract terms, scientific jargon, use of positive tense, special vocabulary and much more. This means teachers introduce and support new words carefully and patiently help children comprehend the newly introduced technical and scientific words. Scientific language also include words with everyday meaning that students are familiar with but these words may
also have special meaning and use in a scientific context. Whether it is a newly introduced term or a known word with a new meaning, to explain a phenomenon, children need opportunities to use these words in order to make sense of them. Becoming familiar and knowledgeable of scientific language may take time and teachers should be supportive in children constructing meaning (Newton, 2002).

Children notice the interconnected nature of knowledge and learning when activities and discussions develop from their interests. Lessons and topics from different disciplines become more interconnected, meaningful, engaging, and functional. Paying attention to student interests during instruction not only increases student involvement but also increase their contribution to the classroom activities as they make more sense of their learning. In such classrooms, students’ attention to tasks and practices increase significantly and eventually lead to better academic success (Fisher, 1991).

Positive gains in learning are also reported when students are given more authority over the control of the classroom conversations. Students tend to get involved in classroom talk and learning activities more frequently as they begin to have a say in the direction and nature of classroom conversations. Students to reflecting on each other’s views and ideas provide them an opportunity to observe and interact with their peers and teachers while making each other’s thinking more visible to themselves and to the teacher (van Zee & Minstrell, 1997). In their examination of classroom talk and teacher-student interactions that is evident in the dialogues take place daily in the classroom, van Zee and Minstrell (1997) pointed out that “reflective discourse” helped students shared their ideas and thinking processes more freely. Questions allowed teachers to help their students better analyze the validity of their and other’s statements in a neutral way while monitoring the classroom discussions. Students have a chance to clarify
their own thinking processes and revise their understanding of concepts during classroom
discussions as teacher questions in reflective discourse are not intended to test student
knowledge but to help students better articulate their conceptual understanding of the topic.
Discussions built upon previous student utterances and aimed for inquiry teaching in science
require teachers constantly adjust their questioning in order to accommodate student ideas,
beliefs and conceptions.

Teachers providing opportunities for interaction for each and every student in the
classroom is essential for children’s learning (Mercer & Littleton, 2007). One to one interaction
and individual teaching may offer opportunities for teachers to provide extended help for any
particular student. On the other hand, as doing so, teachers may have less time to devote to others
in the classroom when they make themselves available for such one to one interactions. A similar
dilemma is in place for the classroom activities that require teacher guidance and help. More
time is devoted to individual interaction during more demanding classroom activities for those
who need but the less support will be available for other students. Less demanding classroom
activities will require less attention to individual support but at the same time, those activities are
more likely to demand less of a child effort and dedication as well (Alexander, 1992).

It is a widely accepted fact that teacher questions are important part of classroom
interaction and students learning, and conceptual understanding enhance with proper use of
questions (Mercer & Littleton, 2007; Wells, 1999). On the other hand, eliciting the reasoning
behind student answers may not always be the case for some teachers. Wood (1992) critiques
teachers’ extensive and ineffective use of questions and claims that most teachers use questions
just to get one brief answer which usually is already provided to learners at some extent in
teachers' earlier statements. Therefore, answers are more of a reiteration of information for
children and they are suppressed to make any contribution to the teaching and learning through talk. Children need opportunities to participate in classroom talk and reducing the number of questions they are exposed to help them contribute to the classroom talk, more often with an increase in the length of their contributions.

Teachers, structuring questions to initiate higher order thinking and using student answers to provoke further questions are all essential for student success and cognitive development. Quality teacher-student interaction and teacher-student relationship are necessary for this purpose and often lead to effective classroom instruction and improved student learning not only in science but in all subject areas (Alexander, 2011). Research on nature and quality of teacher-student interactions and its relationship to students’ understanding of science in elementary classrooms, where student centered teaching and learning practices take place, may provide invaluable information about effective science teaching.
CHAPTER 3

METHODOLOGY

Overview

Most scholars agree that learning is an active process where learners construct their own understanding by making sense of their experiences and environment. As one of the leading experts, von Glasersfeld (1993) asserts that learners are not empty vessels or passive receivers into which knowledge can be transferred. In contrast, learners are thought to construct knowledge through an active construction process, and each learner develops his or her own understanding. Arguably, the role of the teacher is critical in shaping the child’s understanding. It follows that the nature of the interaction between teacher and child is important.

Teacher-student interaction is important because it can help create opportunities for children to become self-directed learners. Cognition develops through encounters with new and different stimulating information that is then assimilated into present understanding. Constructivism rightly stresses this essential relationship between new experiences and the ones already known. Individuals learn and construct their own understanding as to the level which they can relate new experiences to their needs and interests. Meaningful effective interactions with others, including teachers, can significantly enhance learning and understanding (Watson, 1996).

Children learn through their social interactions and communications with others (Watkins, 2006). In classrooms, teacher-student talk is a powerful way of establishing quality teacher-student interactions and supporting student understanding in science. Teachers can foster student learning and help children make sense of their own thoughts through talk. Quality
teacher student interactions that are present in classroom talk increase the likelihood of students developing a well-founded scientific understanding (Newton, 2002).

During traditional lessons, classroom talk usually takes place in a three step sequential dialogue between students and the teacher. This three-step sequence of talk starts with teacher initiation, and is followed by student response and teacher evaluation or teacher feedback. As educational goals change and become more complex, the classroom talk and complexity of dialogue patterns between students and teachers also changes. Instead of following a strict sequential pattern of teacher initiation - student response - teacher evaluation, many teachers try to use classroom discourse that is more open, and talk that promotes inquiry and discussion. In non-traditional student-centered classrooms, classroom talk does not necessarily fit to an initiation-response-feedback structure, and students can reflect on each other's responses and collectively inquire solutions to problems. As a classroom learning community, students explain and share their views in order to validate their responses and ideas through interaction with their peers and the teacher. Within such classrooms the teacher is more of a facilitator of such validation, rather than being the sole authority (Cazden, 2001).

Teachers who have high expectations of their students and who support their students’ communicative efforts contribute to the quality of classroom interaction (Cazden, 2001). In contrast, vagueness in teachers’ classroom talk can increase children’s frustration and potentially lead to academic failure (Watson, 1996). Spending excessive time telling students what to do during activities often gets the task done for both the teacher and students. However, such interaction neither pushes for meaningful progress in students’ thinking nor their reasoning and understanding (Parker-Rees, 1996). Recent research reveals that teacher-student conversations are often quite brief and dull, and disappointingly unrewarding for both teachers and students.
The length of a conversation between teacher and child does not necessarily mean that is also quality interaction (Watson, 1996). The quality of the educational talk that takes place in the classroom and its effects on students’ educational success or failure are of considerable importance. Thus, accomplishing better student outcomes requires attention to the relationship between language, thinking, learning, and cognitive development (Mercer & Littleton, 2007). Detailed analysis of teacher student interactions and the content and nature of classroom conversations is important so that we can better understand how children learn science in classroom contexts. It follows that examining the roles of both teachers and students during verbal interaction can provide the basis for judgments about student learning (Hamre & Pianta, 2001; Newton, 2002; Watson, 1996).

The purpose of the study was to explore the nature and quality of teacher-student interactions in a third grade science classroom and to investigate its connections to teacher-student relationships and student learning. It is important to examine teacher-student interaction and dialogue patterns during instruction because it is not only necessary for determining the factors that may influence students’ science understanding, but it is also important for determining the type and nature of teacher-student interactions that may inhibit or stimulate students’ learning in science. The main focus of the study was to explore the relationships between teacher student-relationships and teacher-student interactions and student learning.

**Rationale**

The previous chapter described how social interaction in general and teacher-student relationships, teacher-student interactions and classroom talk play a role in children’s learning from a sociocultural perspective. The review highlighted the fact that children learn as they interact with others and with their environment. Moreover, their success is strongly related to the
quality of the interactions that they establish with significant others, including their teachers. Clearly, it is important for researchers to use appropriate methods whenever they conduct research. The research questions and the methods chosen for any study should align with the theoretical framework (Gee & Green, 1998; Patton & Patton, 2002). The current study investigated the research questions from a sociocultural perspective and therefore it utilized an approach that allows moment-by-moment recording and analysis of interactions, or real time analysis of talk as it occurs during science lessons. Observation of each teacher student interaction that takes place during classroom activities, and the way teachers interact with their students through classroom discourse should allow the researcher to better understand how children’s come to learn science concepts.

Kelly, Chen, and Crawford (1998) suggest that the theory and the methods used should be mutually informing and interactive, and should allow the researcher to interpret results from the light of one or another. It is well established that social interaction and participation in social exchanges is necessary for internalization of learning (Rogoff, 1995; Wells, 1999, 2000). Similarly, students’ interest in learning is strongly influenced by teacher-student interactions in the learning environment (Wubbels & Levy, 1993). Investigating the research questions for this study requires the use of classroom observations and discourse analysis as the main form of data collection. The success of students in science strongly depends on their interactions with others and the way they engage in classroom talk during science lessons (Erickson, 1998). The study therefore examines the connections between teacher-student relationships and teacher-student interactions.

The intent of this quantitate study was to investigate teacher-student interactions in a natural setting. To this end the everyday context of the classroom activities and interactions were
used to seek answers to the research questions. The purpose of the study is not to impose a treatment on a particular group of students, or determine the differences between a control and treatment group. Rather, the study identifies the nature and quality of interactions that take place during science lessons in a real time environment. The natural observation of the classroom allows the researcher to observe teacher-student interactions exactly as it occurs in the classroom.

Teachers interact with each of their students several times during a single lesson and investigation of each verbal exchange and determining the nature of that exchange requires the recording and analysis of an extensive amount of data. It is common in quantitative research that a much smaller group of people is used to gather data and researchers attempt to answer their research questions about the population by studying a smaller sample (Gall, Gall, & Borg, 2007). In the current study, the representative sample of interactions which the researcher observed and recorded during science lessons provided a picture of teacher-student interactions which can potentially have an effect on students’ science learning. Drawing and analyzing a sample of interactions from the countless number of interactions that take place during each school year is only feasible using quantitative methodology. The study investigated a sample of classroom interactions in order to seek answers to the research questions. In doing so the researcher made careful observations of any contact between a student and the teacher and categorized each interaction into appropriate and relevant categories that could influence third-grade students’ understanding of science concepts.
Students and Teacher

The participants were an intact class of third grade elementary school students and their teacher. The participating classroom was selected using the convenience sampling method from one of the schools in the northwest region of Florida.

It is well known that children’s cognitive development and learning improves as they get older and that it is when children are in the third grade that their social interaction with others, and the social environment that they are involved in, becomes increasingly significant and more complex (Baker, 1999; Selman, 1980). It is also documented that children begin to use social comparisons to evaluate themselves as they move through the early school years (Selman, 1980), and their ability to establish quality relationships contribute to their academic outcomes (Burchinal et al., 2002; Hamre & Pianta, 2001; Kochenderfer & Ladd, 1996; Pianta & Stuhlman, 2004). Pianta (1999) rightfully stresses the importance of quality teacher-child relationships on social adjustment of students to the classroom environment during primary grades and relates it to the future success or problems of students at school. It is also about the third grade that science curriculum become more demanding (Baker, 1999) and investigating teacher student interactions during the third grade may yield invaluable information regarding future success of our students in science. Thus, the elementary school grades, and the third-grade in particular, could be more useful and important for investigating teacher-student relationships.

The study was conducted in a K-12 laboratory charter school. The classroom teacher was a white female who had been teaching for nine years. She was very energetic during the instruction and was observed to be a very confident teacher. The research study involved 17 third grade elementary students as participants. The researcher was able to obtain enough consent forms from the selected classroom of 18 students, except one child whose parents did not consent
for her to participate in the study. A class of 17 participants was considered ideal for the purpose of the study as more participants could have prevented the researcher from recording and coding each moment-by-moment interaction in detail. Further, an excessively large number of interactions might have made it difficult to draw valid conclusions about the nature and meaning of such interactions. Limiting the number of participants under twenty students was beneficial in order to effectively capture the details of each teacher-student interaction. A very crowded classroom with more than twenty students would have limited the number of individual teacher-student interactions and the time the teacher could devote to each child in the classroom. The researcher recorded, coded, and analyzed each moment-by-moment interaction between the teacher and a particular student in 3 to 5 second intervals as recommended by Amidon and Flanders (1967).

**Setting**

The setting for the study was a student-centered, inquiry-based elementary school science classroom where teacher-student interaction was evident during classroom activities. The study was conducted in a K-12 laboratory charter school sponsored by a southeastern university that provides extensive research and development opportunities for educators. The school currently serves approximately 1700 students from the surrounding county and the student demographics are similar to the other typical school sites in Florida. About 50.2% of the students enrolled in the school are female and 49.2%, males. The student population consists of students from different income levels and ethnicities. The percentage of the students per ethnicity was as follows: White, African American, Hispanic, Asian, and other is as follows: 50.1%, 29.3%, 12.1%, 3.1% and 5.4%. 
The study required the researcher to record, transcribe and analyze the audio and video recordings of each conversation between a particular child and the teacher during the science lessons for a period of eleven class sessions in a third grade elementary classroom. The first two class sessions of the observations served as preliminary observations in order to reduce potential observer effects. The initial data collected were used to determine the appropriateness of the proposed interaction-types and their classification into the various categories. The researcher used both audio and video recording to capture the classroom interaction. Such an approach provides better opportunities for accurate examination of the complex nature of teacher-student interactions during science lessons. The use of two types of recorders allowed the researcher to record all types of conversational teacher-student interactions that may take place during the instruction, regardless of where it takes place within the classroom. The researcher set up the camera somewhere at the back of the classroom in a place looking towards the teacher and the students where all interactions in the classroom could be viewed and recorded. In addition to the video camera, the researcher also used an audio recorder in order not to miss any teacher-student conversation that might have taken place far away from the camera. The researcher strapped the audio recorder to the teacher and used it as a backup source for those conversations not being heard in the video analysis due to classroom noise. As such, the researcher was able to capture all conversations within a loud classroom environment including the quiet conversations of students located far away from the camera.

**Approval Procedures**

The researcher applied to the Human Subjects Committee at FSU in order to obtain approval for the study. Having received the approval for the study and appropriateness of the human subjects consent and assent forms, the researcher contacted the administrators of a K-12
laboratory charter school and sought approval for the study. The researcher briefly explained the research intent, consent information, measurement scales, and procedures to the school administrator directing the research studies at the school. The school approved the research study and provided the names of the teachers who are available and might be interested in participating in the study. The researcher scheduled and had a meeting with one of the volunteering teachers and explained the procedures and the research intent to the classroom teacher. Having discussed the details and having agreed on a time table with the classroom teacher, the teacher was asked to sign the teacher consent form and also provided child assent and the parental consent forms to distribute to the parents in order for the researcher to obtain permission to conduct research with their children. Consent and assent forms provided a brief summary of the research study and the parents were also assured in the written consent form that there are no risks involved due to their participation in the study and all information collected during the study will be confidential. The participation in the study was totally voluntary and the consent and child assent forms clearly explained that non-participation of the subjects would not affect students’ class standing in any way. Only children with signed consent and assent forms were included in the study and they were informed that they could withdraw from the study at any time.

**Data Collection Procedures**

Interaction with others is a complex process and requires moment-by-moment recording with attention to each one-to-one contact for a detailed analysis. Researchers suggest the use of audio and video recorders as a tool for research on teacher student-interactions and classroom talk (Cazden, 2001; Cicourel, 1980). Both teachers and students may engage in several activities and tasks during each lesson. During these activities teachers may interact with several students at the same time for the same or different reasons. In these interactions teachers may instruct
several students while paying some particular attention to one other child. Simultaneous interactions such as addressing a student for behavioral issues, asking another for participation or yielding a question to another may all take place during the same time frame. Such complex classroom environment requires researchers to look into these interactions in detail in order to avoid misjudgments and unintended classification errors. Recorded data allows the researcher to view and reanalyze each interaction repeatedly and prevent any interaction to be unnoticed or miscoded.

In this research study, the video and audio recordings of the science classroom were used to examine the teacher-student interactions. The coding of teacher-student interactions was made with particular attention to the transcripts of the science lessons recorded by the video camera. Video recordings provided the picture for the overall context of the teacher-student interactions as they took place in the classroom and allowed for detailed analysis. The audio recorder was also used in order not to miss any teacher-student conversation that took place far away from the camera. After collecting the data the researcher transcribed all of the video recordings.

Transcription of each class session was analyzed by examining each teacher-student conversation that occurred in the classroom. Any teacher-student interaction that took place during the instruction was coded into the appropriate interaction type. The researcher recorded interactions individual students into the spreadsheet, and subsequently calculated frequencies for each interaction type for the individual student.

The researcher cooperated with the classroom teacher and determined a science unit on the solar system to be most suitable for the purpose of the current study, and rich in terms of teacher-student interactions. The science unit was a section of the third grade science textbook adopted by the district and was part of the science curriculum. The science unit covered concepts
related to the solar system and aimed to answer the questions such as; “What patterns do the Earth, Sun, Moon, and stars show?” and “How are the planets in the solar system alike and different?” Some of the Florida science benchmarks for the science unit were:

- The student knows that most things that emit light also emit heat.
- The student knows that the tilt of the Earth on its own axis as it rotates and revolves around the Sun causes changes in season, length of day, and energy available.
- The student knows that the combination of the Earth’s movement and the Moon’s own orbit around the Earth results in the appearance of cyclical phases of the Moon.
- The student knows that a model of something is different from the real thing, but can be used to learn something about the real thing.

The lessons were planned by the classroom teacher and designed to accomplish the objectives of the science unit. Some of the lesson objectives were:

- The student makes predictions and inferences based on observations.
- The student knows that the Sun provides energy for the Earth in the form of heat and light.
- The student explains how the movement of Earth in relation to the Sun determines the pattern of day and night.
- The student knows that days and nights change in length throughout the year.
- The student knows the patterns of average temperatures throughout the year.
- The student explains how the Moon and Earth interact.
- The student describes ways to study stars.
• The student explains how constellations are in patterns that are stable.

• The student knows that, in addition to the Sun, there are many other stars that are far away.

• The student knows the relative positions of all the planets.

• The student knows characteristics of Mercury, Venus, Earth, and Mars.

• The student knows that the planets differ in size, characteristics, and composition and that they orbit the Sun in our Solar System.

The researcher and the classroom teacher worked together and developed a science unit test based on the objectives until all the signed consent and assent forms are received. The teacher filled out the Student-Teacher Relationship Scale (STRS) for each student participating in the study and the science pre-test is administered to the students during the class time before the preliminary observations began. The preliminary observations included two class sessions and the data obtained from the videotape and audiotape recordings were transcribed. After the transcription the researcher coded each teacher-student interaction to one of the twelve interaction types. The researcher used the data from the preliminary observations in order to determine the appropriateness of the proposed interaction-types and their ability to capture the classroom interactions. The researcher’s visit to the classroom during the preliminary observations provided an orientation period for the students to get used to the presence of the researcher in the classroom and in turn, limited any reaction effects. The researcher placed the video camera in the corner of the classroom and in a location that would not interfere with the instruction. No field notes were taken during the observations. Furthermore, the researcher did not discuss the lessons or observations with the classroom teacher, either before or after the class sessions. The researcher conducted a total of nine hours of observations during the science unit.
The observation hours depended on the time devoted to instruction of the science unit by the teacher and captured the instruction of all topics covered in the pre-and post-test. The class sessions were taught during a three week period. Each lesson lasted approximately thirty five minutes. The lessons included video presentations of the solar system. The students also had an opportunity to observe and record shadow movements in the school yard. Additionally, students were asked to draw the phases of the moon for homework. As part of a hands-on activity, students were asked to act as planets and the sun to simulate the movements of the planets in the solar system. During the four class sessions the teacher asked the students to read aloud from the textbook for about ten minutes. An overhead projector was also used to ask students some questions on the topic twice during the observations. In addition to whole class instruction the teacher also asked for group work and whole class discussions. The students were given an opportunity to freely share their ideas and views during the discussions. Having completed the instruction of the science unit the post-test was administered to the students. The difference between the pre- and post-test scores of students served as a measure, or an indicator, of students' understanding of concepts covered during the science unit.

**Instruments/Measures**

**Student -Teacher Relationship Scale**

The Student-Teacher Relationship Scale (STRS) (Pianta, 2001) was used to assess the quality of teacher-student relationships. The STRS is a widely used teacher side scale assessing the quality of the relationship between the teacher and a particular student.

The STRS is designed to assess teachers' perceptions of their relationship with their students and is validated for use with teachers of students from age 4 to 9 years. The scale consists of 28 Likert type items using a 5-point rating. Teacher ratings for each item are;
definitely does not apply (1), does not really apply (2), neutral or not sure (3), applies somewhat (4), and definitely applies (5). The STRS consists of three dimensions measuring the quality of relationships; closeness, conflict, and dependency. Closeness subscale consists of 11 items and measures the perceived warmth, openness and emotional support between the teacher and the student. Conflict subscale consists of 12 items and serves as a measure of perceived unfriendly, discordant, and uncooperative interactions between the teacher and the student. Dependency subscale consists of 5 items and assesses the degree to which a student is perceived as overly dependent on the teacher.

Pianta (2001) reported high reliability and validity for the STRS. The reliability analysis of STRS has been carried out with a sample of 275 teachers and 1535 students. Internal consistency reliability score of .89 is reported for the total scale and the subscales of closeness, conflict and dependency had Cronbach’s alphas of .86, .92, and .64 respectively. Test-retest reliability estimates are Closeness, .88; Conflict, .92; Dependency, .76; Total, .89.

As the only standardized and validated instrument assessing teachers’ perception of their relationship with their students (Pianta, 2001), STRS has been extensively used in studies looking into teacher student relationships (e.g., Birch & Ladd, 1997, 1998; Kesner, 2000, 2002; Pianta et al., 1995). In a longitudinal study of 179 students following them from kindergarten to eight grade, Hamre and Pianta (2001) investigated if the pre-kindergarten teachers’ perceptions of their relationships would relate to a range of student outcomes in the future. Results revealed that the STRS ratings of teachers significantly correlate to student outcomes from academic success to disciplinary problems. Students who had a conflicted relationship with their kindergarten teachers, regardless of the gender of the student, developed more negative work habits and experienced more disciplinary problems during higher elementary grades. For boys,
poor academic success continued to be an issue throughout the elementary and middle grades. However, positive work habits in lower grades indicated closer relationships with their kindergarten teachers for girls. Thus, fewer disciplinary problems were also reported for girls who had closer relationship with their kindergarten teachers in upper elementary grades. In another study of 436 kindergarten children Pianta (1994) found that pre-kindergarten teachers' perception of their relationships with their students was a strong predictor of possible adjustment problems during the first grade. Dysfunctional teacher-students relationships with kindergarteners predicted poor work habits and social skills in the first grade.

**Teacher-Student Interactions**

Teacher student interactions during the lessons and teacher student talk during the daily routines of the classroom can take several forms and shapes. The richness and the quantity of interactions represent a challenge for any researcher looking into the details and patterns in teacher student interactions (Watson, 1996). Studies investigating the nature of teacher student interactions utilized different classification types to describe the teacher student interactions. Amidon and Flanders (1967) categorized interaction as being direct and indirect where lecturing, directing or criticizing is considered direct interaction and encouraging, praising, questioning, or approving considered as indirect interaction. Others like Pollard (1984), Ramirez (1988) and Baker (1999) used the source of initiation of the interaction as the classification method and investigated teacher-student interactions whether it is being initiated by the teacher or the student. In her study, Baker (1999) categorized teacher initiated interactions and student initiated interactions as negative or positive. She looked into the teacher-initiated interactions from two dimensions as teacher initiated contact regarding academic work and teacher initiated contact regarding behavior. Student initiated interaction had only one dimension of academic work.
Watson (1996) investigated the teacher side interactions and categorized the “teacher talk” into six different categories. These categories included assessing, which stands for teacher assessing the student’s knowledge on a particular topic or asking for clarification; encouraging reflection, teacher asking student to justify his/her answer and provide further explanation; keeping on task, teacher commenting on student’s progress and providing feedback; modeling, teacher providing examples of reflective thinking; promoting independence, teacher emphasizing originality and uniqueness in students work; and including peers, teacher encouraging other students in the classroom to contribute to each other’s ideas and comments.

The researcher developed and used a classification system based on the research findings suggesting children’s’ social competence and understanding improve as they interact with more knowledgeable others (Watson, 1996). The nature of teacher student interactions and the quality of those interactions are important to make any inferences regarding their effect on students’ science understanding. Having reviewed the literature on science education and teacher-student interactions discussed in chapters one and two, the researcher created a list of interaction types and tried to categorize them into related groups. The final list of teacher-student interactions included:

1. Closed Question (CQ)- to diagnose student understanding, information seeking, require short answer or recall (e.g., Flanders, 1970; Wood, 1992).

2. Open-ended Question (OQ)- to extend student ideas, leading for higher order thinking and reasoning (e.g., Alexander, 2011; Cohen, 1994; Flanders, 1970; van Boxtel, van der Linden, & Kanselaar, 2000).

3. Scaffolding Questions (SQ)- to further elaborate student ideas, series of questions back and forth, exchange of ideas between the teacher and the student (e.g.,

4. Clarifying (CL)- to make a comment on a response or a question with an intention of understanding/teaching or feedback. (e.g., Student states “If penguins were birds they would fly” The teacher states “Not all birds can fly, like penguins and ostriches. They have lost their ability to fly in time and live on ground. But they are still birds…” ) (e.g., Flanders, 1970).

5. Restating (RS)- to restate student answer or question in an effort to attract student’s attention to the answer or the question. (e.g., “So, the longest river in the US is the Mississippi river” or after a question of a student “Which one is bigger the sun or the moon?” the teacher restates “Yes, which one you think is bigger, the sun or the moon”) (e.g., Hogan, Nastasi, & Pressley, 1999; Walsh, 2006).

6. Praise (PE) - to express warm approval, setting a good example for others. (e.g., “Nice drawing Alan, keep up the good work!”) (e.g., Becker, 1981; Flanders, 1970; Mercer & Littleton, 2007).

7. Positive Comment (PC)- to express approval, praising, encouraging, expression of satisfaction (e.g., Teacher: “Do you know what city we are in now?” Student: “Tallahassee” Teacher: “Good” and teacher turns way and continues his/her lesson) (e.g., Flanders, 1970; Mercer & Littleton, 2007).
8. Negative Comment (NC)- to express disapproval, expression of dissatisfaction. (e.g., “You did not listen well yesterday, and now you do not understand what I say”) (e.g., Flanders, 1970)

9. Directive Comment (DC)- to state a command or request certain behavior to be presented. (e.g., I want you to open up page thirteen in your book”) (e.g., Flanders, 1970; Swann, 1992).

10. Disciplinary/Warning Comment (DWC)- to a set or system of rules and regulations, enforcing for certain behaviors. (e.g. “Julie I won’t warn you again, sit down!”) (e.g., Flanders, 1970).

11. Minimal or No Comment (MC)- to express frustration, or total ignorance with no comment or help. (e.g., The teacher asks “Do you know of a mammal”, one student answers “lizard”, the teacher either says no or simply turns around and looks for another student to answer ) (e.g., Hughes, 1973; Patchen, 2006; Ryan, Gheen, & Midgley, 1998).

12. Individual Instruction (II)- to further improve student understanding, providing additional help for catch up (e.g., Becker, 1981; Rodgers, 1988).

The researcher used two levels of grouping (see Table 3.2). The first group is the nature of the interaction and it includes three dimensions; positive, negative and neutral. The positive interactions group includes the interaction types of; Positive comment (PC), Praise (PE), Individual instruction (II), Open-ended question (OQ), Scaffolding questions (SQ) and Clarifying (CL). The negative interactions group includes the interaction types: Negative comment (NC), Disciplinary/warning comment (DWC), Minimal or no comment (MC). The
neutral interactions group includes the interaction types of; Closed questions (CQ), Restating (RS) and Directive comment (DC).

The second group of interactions looked into the quality of the teacher student interactions. The literature supports that the interaction between the teacher and the student may take place in different ways and quality of the teacher student interactions has certain aspects to it. For example, the use of open-ended questions and feedback is considered to be the components of quality teacher student interactions. Therefore, the group looking into the quality of the teacher student interactions has two dimensions to it: higher quality interactions and moderate quality interactions. The higher quality interactions group includes the interaction types of Open-ended question (OQ), Scaffolding questions (SQ), Praise (PE), Individual instruction (II), and Clarifying (CL). The moderate quality interactions group includes the interaction types: Positive comment (PC), Negative comment (NC), Disciplinary/warning comment (DWC), Minimal or no comment (MC), Closed questions (CQ), Restating (RS) and Directive comment (DC).

In sum, the researcher used twelve types of interactions and categorized them into two different groups looking into the nature and quality of the teacher-student interactions. Each group had multiple dimensions as to better explain the variations of the teacher-student interactions in the classroom. Prior to the study the researcher prepared a coding sheet for each of the participants. The coding sheet contained a column for all the twelve interaction types and each interaction between the teacher and the student was coded into the appropriate category on the coding sheet. After coding the observed interactions, the researcher calculated the frequencies of teacher student contacts within each category. The researcher also calculated the means and standard deviations and tabulated the frequencies for all of the dimensions.
Inter-rater reliability becomes necessary since the research conducted in this study based on the observational measures. The degree of the agreement between the observers is called inter-rater reliability and it is usually measured with correlation techniques (Bakeman & Gottman, 1997). In order to obtain inter-rater reliability a second observer was trained by the researcher through the preliminary observations. All the definitions and the interaction categories were explained in detail to the second observer. The researcher and the second observer individually watched one of the preliminary observations from the videotapes. Each coder transcribed the video and coded the teacher-student interactions to the appropriate categories. The researcher and the second observer continued to code and recode the videotape until 80% agreement was reached. During the study, the researcher and the second coder individually transcribed and coded the first classroom observation in order to provide information on inter-rater reliabilities.

Students' learning of concepts during the science unit was measured by the pre- and post-tests developed by the researcher and the classroom teacher. The pre- and post-tests were developed to evaluate the students' understanding of the concepts covered in the selected unit which was part of the science curriculum adopted by the district. The researcher and the teacher worked together and derived forty multiple-choice questions from the textbook and the workbook. The test questions were constructed based on the objectives of the science unit outlined in the textbook. The following are the sample questions from the science unit test:

Q1. What causes night and day on Earth?
   a. The rotation of Earth.
   b. The moon moving around Earth.
   c. Earth revolving around the sun.
   d. Wind moving across Earth.
Q2. What causes the seasons on Earth?
   a. Earth’s tilt and movement around the Sun
   b. Earth’s rotation on its axis
   c. Earth’s movement around the Moon
   d. Moon’s movement around the Earth

Q3. Why do some stars appear dimmer than others?
   a. They are bigger than other stars.
   b. They are hotter than other stars.
   c. They are closer to Earth than other stars.
   d. They are farther away from Earth than other stars.

Students were given the pre-test at the of the science unit during the class time. It took about thirty-five minutes of the class time to administer the test. The post-test was delivered after the completion of the science unit during the class time and students took about thirty minutes to answer all the questions. The researcher calculated the mean difference between each student’s pre- and post-test scores and these values served as the student outcome scores. The researcher was also able to observe the student performance and participation in classroom talk and discussions during the instruction of the science unit.

Data Analysis

The purpose of the study was to explore the nature and quality of teacher-student interactions in third grade science classrooms and to investigate its connections to teacher-student relationships and student’s understanding of concepts during the science unit. Specifically, the study was guided by the following questions:

1. What is the nature and quality of teacher-child interactions during science lessons?

2. Is there a relationship between teacher-child interaction and teacher-child relationship?
3. Is there a relationship between teacher-child interaction and third-grade students’ conceptual understanding of science?

4. Is there a relationship between teacher-child relationship and third-grade students’ conceptual understanding of science?

The nature of teacher student interactions and the quality of those interactions were classified into appropriate groups and categories using the classification system developed by the researcher. The classification system had twelve types of interactions categorized into two different groups looking into the nature and quality of the teacher-student interactions.

The first group, nature of the interactions, includes three dimensions: positive, negative and neutral. Interaction types that are included under these three dimensions are categorized as:

Positive interactions:
- Positive comment (PC)
- Praise (PE)
- Individual instruction (II)
- Open-ended question (OQ)
- Scaffolding questions (SQ)
- Clarifying (CL)

Negative interactions:
- Negative comment (NC)
- Disciplinary/ warning comment (DWC)
- Minimal or no comment (MC)

Neutral interactions:
• Closed questions (CQ)
• Restating (RS)
• Directive comment (DC)

The data from the coding sheets for teacher interactions with each individual student were entered into the tables using the SPSS software. The researcher calculated the frequencies of teacher student contacts for each type of interaction. The interactions were tabulated under the proposed dimensions looking into the nature of interactions and frequency tables are created; means scores and standard deviations were calculated. The second classification group for teacher student interactions is the quality of the interactions. Quality of interactions group consists of two dimensions; high and moderate quality interactions, and the interaction types for quality of the interactions dimension are categorized as:

High quality interactions:
• Open-ended question (OQ)
• Scaffolding questions (SQ)
• Praise (PE)
• Individual instruction (II)
• Clarifying (CL).

Moderate quality interactions:
• Positive comment (PC)
• Negative comment (NC)
• Disciplinary/warning comment (DWC)
• Minimal or no comment (MC)
• Closed questions (CQ)
Using the frequencies of teacher student contacts for each type of interaction from the SPSS software, the researcher tabulated each interaction under the dimensions looking into the quality of interactions and frequency tables were created; means scores and standard deviations were calculated.

Table 3.1

*Dimensions of Teacher-Student Interactions Investigating the Nature and Quality*

<table>
<thead>
<tr>
<th>Nature of interactions</th>
<th>Quality of interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Positive comment (PC), Negative comment (NC), Disciplinary/warning comment (DWC), Minimal or no comment (MC)</td>
</tr>
<tr>
<td>Negative</td>
<td>Closed questions (CQ), Restating (RS) and Directive comment (DC)</td>
</tr>
<tr>
<td>Neutral</td>
<td>Open-ended question (OQ), Scaffolding questions (SQ), Praise (PE), Individual instruction (II), and Clarifying (CL)</td>
</tr>
<tr>
<td>High</td>
<td>Positive comment (PC), Negative comment (NC), Disciplinary/warning comment (DWC), Minimal or no comment (MC), Closed questions (CQ), Restating (RS) and Directive comment (DC)</td>
</tr>
<tr>
<td>Moderate</td>
<td>Positive comment (PC), Negative comment (NC), Disciplinary/warning comment (DWC), Minimal or no comment (MC), Closed questions (CQ), Restating (RS) and Directive comment (DC)</td>
</tr>
</tbody>
</table>

Pearson product moment correlations were calculated to examine the associations between teacher-student relationships and teacher-student interactions. The correlations are reported between the three dimensions of teacher-student relationship scale (Closeness, Conflict,
Dependency) and the teacher-student interactions including the dimensions explaining the nature and quality of teacher-student interactions (e.g., Murray & Murray, 2004). In addition, the researcher obtained correlations between all variables of teacher-student relationships and interactions, and students’ understanding of concepts during the science unit. Zero order correlations (Pearson r) were used to report the interrelations between all of the variables.

Table 3.2

List of variables (does not include teacher-student interaction dimensions)

<table>
<thead>
<tr>
<th>Teacher-student relationships</th>
<th>Teacher-student interactions</th>
<th>Conceptual understanding of science</th>
</tr>
</thead>
<tbody>
<tr>
<td>closeness, conflict, dependency</td>
<td>Positive comment (PC), Praise (PE), Individual instruction (II), Open-ended question (OQ), Scaffolding questions (SQ), Clarifying (CL), Negative comment (NC), Disciplinary/warning comment (DWC), Minimal or no comment (MC), Closed questions (CQ), Restating (RS) and Directive comment (DC)</td>
<td>Mean difference of pre- and post-test scores</td>
</tr>
</tbody>
</table>

The researcher sought to identify the nature and quality of teacher-student interactions that take place during science instruction and determined which of the teacher-student relationship and interaction variables, including all dimensions, are related to each other. The links between teacher-student relationship and interaction variables and students’ understanding of concepts during the science unit are also be reported.
CHAPTER 4

RESULTS

This study examined the nature and quality of teacher-student interactions in a third grade science classroom and investigated how interactions and teacher-child relationships relate to the learning of science concepts. Based on the research questions, this chapter reports the results of the study. The relationships between the three dimensions of teacher-student relationships (Closeness, Conflict, and Dependency) and teacher-student interactions including the dimensions explaining the nature and the quality of teacher-student interactions were examined. The study also determined whether there was a relationship between students’ conceptual understanding of science and all variables of teacher-student interactions and the teacher-student relationships.

First, data from the videotape and audiotape recordings were transcribed, coded and analyzed to determine the appropriateness of the proposed interaction-types and their classification into the categories. The twelve teacher-student interaction categories were able to explain the distribution of each teacher-student interaction into one of the twelve interaction categories. Second, each teacher-student interaction was placed into the respective dimension and group. Finally, Pearson Product Moment Correlations were computed to explore the possible relationships between the teacher-student interaction and teacher child relationship and conceptual science understanding.

Teacher-student interaction scores were obtained through natural observations of eight- to nine-year-old children. Students were rated by their teachers using the STRS in order to obtain teacher child relationship scores. Similarly, conceptual science understanding scores were obtained through pre- and post-tests delivered at the beginning and end of the science unit. The results of the analyses are presented in the order of the research questions.
Pearson Product Moment Correlations (Pearson r) were used to report interrelations between all of the variables. As a reminder, specific research questions for this study are:

1. What is the nature and quality of teacher-child interactions during science lessons?

2. Is there a relationship between teacher-child interactions and teacher-child relationships?

3. Is there a relationship between teacher-child interactions and third-grade students’ conceptual understanding of science?

4. Is there a relationship between teacher-child relationships and third-grade students’ conceptual understanding of science?

Participants included 17 third-grade students (table 4.1). The majority of children were 9 years old and the mean age of the participants was 8.88 (SD = 0.33). The majority of students were female (10 female and 7 male). Among the students, 41.2% were Black, 41.2% were White and 17.6% were Hispanic. For each participant three types of data were collected: Conceptual understanding of science, teacher-child relationship, and teacher child interactions. The teacher rated each participant child in her classroom by completing the questionnaires measuring teacher’s perceptions of teacher-child relationships. Teacher-child interactions were assessed through natural observations. Conceptual science understanding scores were obtained through pre- and post-tests delivered at the beginning and end of a new science unit.
Table 4.1

Participants

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</tr>
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<td>88.2</td>
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<td>17.6</td>
<td>17.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

What is the Nature and Quality of Teacher-Child Interactions During Science Lessons?

In order to comprehend the nature and quality of teacher-child interactions, the observations and the video and audio recordings made during the instruction of the science unit were analyzed in terms of teacher-student interaction and dialogue patterns. Data obtained from the recordings were coded into the appropriate types and categories of teacher-student interactions. The coding of teacher-student interactions was made with particular attention to the transcripts of the science lessons recorded by the video camera. Even though the transcripts from the sound recorder is essential for recording the conversations that happen away from the camera, the video transcripts is also vital part of the transcription process as to determine and point out who the teacher talked or responded to during classroom instruction.

Coding task was employed as comparing one unit of information with the next in looking for recurring regularities. Collected data involved these regularities in the form of repeated actions, statements, phrases and questions. Having reviewed the literature on science education and teacher-student interactions in chapter one and two the researcher created a list of interaction...
types and categorized them into related groups. The transcribed data was labeled with the proposed codes and the labeled interactions were categorized into the appropriate groups of interaction categories.

As proposed by the researcher, the study utilized and used twelve types of interactions. Each interaction is initially categorized into two different groups looking into the nature and quality of the teacher-student interactions. Each group also has multiple dimensions as to better explain the variations of the teacher-student interactions in the classroom. The following are proposed teacher-student interactions.

**Closed Question (CQ)**

To diagnose student understanding, information seeking, require short answer or recall. Following are the examples from the video and audio recording data that were coded as Closed Question.

**Example 1:**

Teacher: So it says as in March, neither end of the axis points towards the sun. So it’s kind of in the middle is what it is saying. Ok. Right! There’s not a side that is pointing more towards the sun, it’s kind of, even sort of, and so it’s kind of like the seasons are changing. Ok? In September, we are switching from the summer moving into what season? Claire? We will go from summer and move into the what? October or November?

Claire: The Fall.

Teacher: The fall. Ok? So it’s warmer in the fall, especially in Florida, right? Still warm but it’s getting cooler because we’re leading towards what’s the next season, Ethan? After the summer, we live towards the fall, it’s getting cooler, and what is it gonna be?

Ethan: Winter?
Teacher: Winter, yes. And they said in March, the axis is still, that kind of saying that where we are at, it’s not really one side is tilted more towards the sun, because in March, we’re kind of leaving that winter season, and we are going into what season, Dennis?

Dennis: In the spring.

Teacher: The spring. In the spring time, it’s still kind of cool, but it’s getting warmer because what do you expect after the spring Lily?

Lily: Summer.

Teacher: Summer. And it just continues like that it does it every year, right?

Lily: Right.

Example 2:

Teacher: Ok. So… sorry it is kind of over here (teacher points out a page in the textbook). Notice that the morning shadow is long and it is on the opposite direction from the sun and it is at east of the sky. Look at the picture above. There’s three different pictures of that basketball hoop. Do you see it?

Students: Yeah.

Teacher: Ok. The first one is what time of day?

Students: Morning.

Teacher: Morning. It tells you that. And it also gives you direction, doesn’t it? What direction are we looking at?

Students: West.

Teacher: West, ok? In the middle what time of day is that?

Students: Midday.
Teacher: Midday. They are giving you these answers and you should get this. And the last one what time of day is it?

Students: Afternoon.

Teacher: Afternoon. What direction are we facing?

Students: East.

Teacher: The East. Ok. James said that the shadow is made that is what at the pictures, notice that the morning shadow is long and opposite direction of the sun. The sun rises on what side? What direction?

Students: East.

Teacher: The east. The sun rises in the east. In the morning, if you look, what direction is that shadow casting towards?

Students: East. West.

Teacher: Adam?

Adam: The west.

James: The east.

Teacher: The west. The other, west. That is okay James. So it’s going towards the west. And is that shadow the same length or height of the basketball hoop?

As seen in above examples from the recordings, the teacher asked questions that usually required short answers. The researcher coded these kinds of questions as Closed Question.

**Open-ended Question (OQ)**

To extend student ideas, looking for higher order thinking and reasoning. Following are the examples from the video and audio recording data that were coded as Open-ended Questions.
Example 1:

Teacher: Can we have a mixture? Alright. Why do you think false, Adam? Because you’re one of the few!

Adam: Because umm Earth doesn’t . . .

Teacher: We always have 24 hours but the sentence is saying that throughout the year, how many hours you have day light kind of changes. Usually with your seasons? Can you please put it together?

Adam: The whole Earth, they don’t have the same seasons like on one side it can be summer and on the other’s gonna be winter.

Teacher: Ok. And think about us right now. Think about us like a couple of months ago when the school started. You woke up and you went to school, and when you woke up, what did it look like outside?

Example 2:

Teacher: How is it blocked? So we can, let’s use the picture on our page. Everyone look at the picture of the tree. The bare tree. But we can see it, right? Does everyone see the shadow? That is kind of casting on the ground. Look at that picture Tommy and now explain it to me how that shadow is happening?

Tommy: It is getting blocked from sun.

Teacher: What is getting blocked from the sun?

Example 3:

Teacher: Earth’s rotation causes day and night. It says that eighty eight percent of you said “it is true”. And 11 percent of you said it is “false”. It is not bad. Not everyone is in agreeance. If you think it is true, raise your hand and tell us why. Lily?

Lily: When the earth circles, one part...
Teacher: When the earth circles what?

Lily: When the earth rotates…

Teacher: Rotates?

Lily: When the earth is rotating, part of it gets daylight from the sun the other part is night time.

Teacher: OK. For those of you said “True” do you agree with what Lily is saying?

Analysis of the data disclosed that teachers asked questions to extend student ideas, leading to higher order thinking and reasoning as seen in above examples from the audio and video recordings. The researcher coded these kinds of questions as Open-ended Questions.

**Scaffolding Questions (SQ)**

To further elaborate student ideas, series of questions back and forth, exchange of ideas between the teacher and the student. Following are the examples from the video and audio recording data that were coded as Scaffolding Question.

**Example 1:**

Teacher: Yesterday you seemed like you had it done pretty well. Okay. So, Can anyone tell me something that they can kind of gather from the information, what type of maybe predictions could you make or the pattern that you may see from what we have charted out from the day. What is something that you noticed? AJ?

AJ: It goes like, it goes like up and down.

Teacher: Can you use directional terms for me like north, south, east, west?

AJ: It is going…
Teacher: What's it?

AJ: The, the sun.

Teacher: The sun, so where does it begin, what side, what direction?

AJ: The east.

Teacher: So, the Sun starts from the east

AJ: and then it goes to the west.

Teacher: Goes to the west, as it just blooms straight across to the horizon?

AJ: No.

Example 2:

Teacher: As earth is rotating on its axis going counter clockwise going west to east, half of earth is facing the sun, the other half is not. So the half that is facing the sun, it is what time of the day?

Students: Night.

Teacher: Daytime. If it faces the sun! If it is not facing the sun?

Students: Night.

Teacher: Night time. Can you always count on that?

Students: Yes.

Teacher: Kind of like a pattern?

Students: Yes.

Teacher: As the day goes farther on, you know the morning, all the way until maybe let’s say 5 o’clock; do you ever see the sun move in the sky?

Students: Yes, Nooo… [Murmuring…]
Teacher: No?

Students: No, never.

Teacher: I want you to pay attention. Well, pay attention tomorrow. Okay. Think about it, in the morning kind of where you see the sun. Oscar says it rises in the east. Okay. What side does the sun set on?

Students: West.

Teacher: The west. Well how did it get there?

Students: It… [Murmuring…]

Teacher: Ohh, it just jumped?

Students: Nooo…

Teacher: And it made its way over? That’s how it did it?

Students: Nooo… [Murmuring…]

Analysis of the data disclosed that teachers asked series of questions back and forth to further elaborate student ideas, exchange of ideas between the teacher and the student as seen in above examples from the audio and video recordings. The researcher coded these kinds of questions as Scaffolding Question.

**Clarifying (CL)**

To make a comment on a response or a question with an intention of understanding, teaching or feedback. Following are the examples from the video and audio recording data that were coded as Clarifying Comments.

**Example 1:**

Teacher: Connor has been waiting about 10 minutes or half an hour, so he has a question that he is dying to ask. Go!
Connor: I actually wanna learn how the sun is moving away, like the earth is turning.

Teacher: Okay. Let’s pretend I am the sun, you are the earth. Show me what we are talking about?

Connor: Okay. [Student stands up and shows…]

Connor: You shine on me, and when I turn.

Teacher: Turn, turn.

Connor: ohhh, you go.

Teacher: So you are facing me and it is the day time right here. Whoooo, Cameron has got daytime.

Students: Whoooo.

Teacher: And you are the earth and you spinning and guess what? This side where it was day what is it turning into?

Students: Nighttt.

Teacher: Night time. Did I go anywhere?

Students: No.

Teacher: Not really, you can’t see me anymore from that side because guess what this side of the earth is blocking me. But sometimes you can see this little white glowing thing in the sky, the? …the moon. Okay. He is going; actually he is going off of my raise. I am helping him glow a little bit. And then eventually the next morning, you end up facing me again and it is again the day time. Alright, you got it? Good deal.

Example 2:

Chloe: [Reading from the book]
Teacher: [Stops the reading] Ok, so it is predictable, it is a pattern, it is something that is going to happen more than likely the same way the next day or just about the same. Okay, if you turn on the news tonight or tomorrow morning it will tell you when the sun is supposed to rise and when it will set. And it will change a little bit each day but since it is predictable meteorologist and weather forecasters they can give us a good idea when it should set. Okay, I want you to come in tomorrow and tell me what time you saw the sun is set, alright, and then I will make sure that I watch the news in the morning and I will let everyone know what time it is supposed to set tomorrow and when you go home tomorrow night, we can see if it is the same time okay?

Students: [Laughing…]

Cameron: How do weather people know?

Teacher: Well they have a lot of computers that help them about. They went to college and they had to learn about it to be a meteorologist.

Connor: How? It is a lot of work!

Teacher: It is a lot of computers that are doing the work but they have to be able to read that information and understand and be able to explain to other people so you know what it looks like… and there is you know how they can kind of tell you when like it is going to rain tomorrow. It is because they look at the weather patterns like on a map. They see that from a satellite what kind of like pressure system, you know how it is real cloudy, then they can kind of see where they are moving towards and if they see that it is coming up, they know ohh it is going to get cooler and there is a really good chance it is going to rain. But if you haven’t really studied it and you haven't been thought that or you didn't learn how to read it. Oh you might not be able to just look at it and know "oh it is going to rain soon". They kind of watch the patterns and figure out where it is going to go. So, they do have to do some work.
Analysis of the data disclosed that the teacher made comments on a response or a question with the intention of understanding/teaching or feedback as seen in above examples from the audio and video recordings. The researcher coded these kinds of questions as Clarifying Comments.

**Restating (RS)**

To restate student answer or question in an effort to attract student/s attention to the answer or the question. Following are the examples from the video and audio recording data that were coded as Restating.

**Example 1**

AJ: It has less daylight

Teacher: It has less daylight so maybe it is moving what?

AJ: More slower.

Teacher: You think it is going slower because it has less daylight. Okay. Changed your mind?

AJ: Yes

Teacher: I didn't even say the real answer yet, we will find out in a little bit.

**Example 2**

Gia: Everybody sees this. I always see the moon and the other half. Always have.

Teacher: You see the moon on the other half.

Gia: Like the dark spot. I kind of like see that.
Teacher: Oh you can see the moon, you kind of see the light side and darker side.

Gia: Yes

Analysis of the data disclosed that the teacher restated student answer or question in an effort to attract student/s attention to the answer or the question as seen in above examples from the audio and video recordings. The researcher coded these kinds of questions as Restating.

Praise (PE)

To express warm approval, setting a good example for others. Following are the examples from the video and audio recording data that were coded as Praise.

Example 1:

Teacher: Oh, now Scott if you press this and if we get it wrong, you are gonna be in so much trouble.

Students: Ooo… [Murmuring…]

Teacher: Do you, ahhh, do you feel confident? Like you will bet me a dollar? Okay, I can’t look. Go ahead Scott.

Students: Wowww… [Cheering…]

Teacher: You were so lucky! Alright, let’s give, let’s give Scott a round of applause! Nice job!

Students: [Cheering and applauding]

Teacher: Again. Hopefully, that helped you out, let you see things a little bit differently if you did not understand it before.

Example 2:

Teacher: Ok? Alright. We have time for a few seconds. Adam is looking amazing. Maybe that’s why he has the most points in this group.
Analysis of the data disclosed that the teacher gave praises to students from time to time in an effort to express warm approval, setting a good example for others as seen in above examples from the audio and video recordings. The researcher coded these kinds of questions as Praise.

**Positive Comment (PC)**

To express approval, encouraging, expression of satisfaction. Following are the examples from the video and audio recording data that were coded as Positive Comment.

Example 1:

Adam: Is this good? You have to subtract how many hours are in every day, minus the hours of daylight?

Teacher: Booom. Right there! [Congratulating Adam with high five]

Example 2:

Teacher: It is tilted also, or kind of slanted. I like that you made that observation Chloe, that's really good. So yes, earth is not broom up right. It is a little tilted. It is on that axis that imaginary line

Analyses of the data disclosed that teacher gave positive comments to students from time to time in an effort to express approval, encouraging, expression of satisfaction as seen in above examples from the audio and video recordings. The researcher coded these kinds of questions as Positive Comment.
Negative Comment (NC)

To express disapproval, expression of dissatisfaction. Following are the examples from the video and audio recording data that were coded as Negative Comment.

Example 1:

James: Can you help on this some?

Teacher: You aren’t listening to what Adam told me

Example 2:

Abby: Earth makes one rotation in twenty four hours.

Teacher: [making a funny sound] Say that word again.

Abby: Earth makes one rotation . . .

Teacher: Wuuuu. Say it again???? Say something different?

Abby: It has a “v” in it.

Teacher: There you go. Revo . . .

Abby: Oouuu

Teacher: A year. So, your answer for number 5 is false; Earth does not make a revolution in a day. We would be going around pretty quick.

Analyses of the data disclosed that the teacher gave negative comments to students from time to time in an effort to express disapproval, expression of dissatisfaction as seen in above examples from the audio and video recordings. The researcher coded these kinds of questions as Negative Comment.
Directive Comment (DC)

To state a command or request certain behavior to be presented. Following are the examples from the video and audio recording data that were coded as Directive Comment.

Example 1:


Gia: Saturn is the sixth planet from the Sun. It’s about 1 billion… [Gia starts reading]

Example 2:

Teacher: The revolution is that big trip around the Sun, and rotating is just kind of like spinning. Right?

Chloe: Yes.

Teacher: Can you stand up and rotate twice? [Chloe]. Stand up and rotate twice. May be a little movement, some of you are sleepy heads…. Okay. So you rotated by your seat. Claire will you make a revolution around all the desks?

Claire: I will make a revolution. It will take a year.

Teacher: I hope it doesn’t take a year.

Students: [Laughing]

Analyses of the data disclosed that the teacher gave a command or requested certain behavior to be presented as seen in above examples from the audio and video recordings. The researcher coded these kinds of statements as Directive Comment.
Disciplinary/Warning Comment (DWC)

To a set or system of rules and regulations, enforcing for certain behaviors. Following are
the examples from the video and audio recording data that were coded as Disciplinary/Warning
Comment.

Example 1:

Connor: I wanna know why Pluto is so small and it’s out the umm bigger planets.

Teacher: You have to wait until we get there. Some of your questions, we are gonna hit a little bit later. And if you wanna have your conversations, you guys could go outside. That’s fine by me. Okay! That is two rows over here. If you need to have your conversations, you can have them outside, so that we can keep going. Alright? Are we Okay?

Students: Yeah.

Teacher: Cos I don’t wanna interrupt! Ok! But I gotta keep going, I’m sorry.

Example 2:

Teacher: Oscar! What happened? You’re what? [Oscar is standing and walking around]

Oscar: Checking the time.

Teacher: Checking the time? Why did you check the time for? You got somewhere to go? No? Alright. Finish that up!

Analyses of the data disclosed that the teacher used expressions and statements to enforce for certain behaviors in order to keep a set or system of rules and regulations in the classroom as
seen in above examples from the audio and video recordings. The researcher coded these kinds of statements as Disciplinary/Warning Comment.

**Minimal or No Comment (MC)**

To express frustration, or total ignorance with no comment or help. (e.g., the teacher asks “Do you know of a mammal”, one student answers “lizard”, the teacher either says no or simply turns around and looks for another student to answer). Following are the examples from the video and audio recording data that were coded as Minimal or No Comment.

Example 1:

Teacher: Because the sun gets warm. Does that make sense? Does anyone think something different?

James: Because the sun gets warm. [Teacher ignores James]

Teacher: Courtney?

Claire: If the sun is down one side, the sun is down on the other side. So evening is cool.

Example 2:

Dennis: Mrs. Smith. [Teacher sees Dennis raising her hand]

Teacher: Alright, so Claire says we are moving.

Claire: We are moving and the sun is going like going like.

Teacher: The sun is here and we are, we are moving. [Dennis is consistently raising her hand]
Dennis: Mrs. Smith. [Teacher sees Dennis raising her hand]

Chloe: And it makes it look like the sun is moving.

Dennis: Mrs. Smith. [Teacher sees Dennis raising her hand]

Teacher: And it makes it look like the sun is moving.

Dennis: Mrs. Smith. [Teacher ignores Dennis’s raising her hand]

Connor: But it is really staying there.

Analyses of the data disclosed that the teacher used expressions and statements to express frustration, or total ignorance with no comment or help as seen in above examples from the audio and video recordings. The researcher coded these kinds of statements as Minimal or No Comment.

**Individual Instruction (II)**

To further improve student understanding, providing additional help for catch up. Following are the examples from the video and audio recording data that were coded as Individual Instruction.

Example 1:

Teacher: Okay. If you need help, please make sure you raise your hand.

I’ll come by, and I’ll help you, and we’ll talk about it. We got some people. Alright, Oscar.

Oscar: I need help
Oscar: Ok, what you have going to here is this number this one relates to number 1, at the top. If this sentences, earth’s rotation causes day and night. If that’s true, after what we have read, we know it is true, you are going to write that same sentence down here for number one. They give you two lines, so you have room. And since that’s true, we are going to put correct. For number 2 though, we found out the earth does not rotate faster. So we are going to put incorrect and then, we are going to actually write the correct statement for it. Earth does not move faster in the winter. Or you can put earth rotates at the same speed all year. You could do that, alright. Did you catch that?

Oscar: Yes

Example 2:

Teacher: [Teacher comes to help Ida]. At any time, blank of earth is facing the sun. At any time, half of the earth is facing the sun, or any time, all of the earth is facing the sun. Why?

Ida: I don’t get it.

Teacher: You don’t get it? Ok. Here is the sun, right? This is the earth.

Ida: Ok.

Teacher: Can all of the earth at one time face you?

Ida: No.
Teacher: No. So this part of the earth can face you, right? The other half cannot, but it’s always spinning and always half of the earth facing it. Does that make sense?

Ida: Yes

Analyses of the data disclosed that the teacher used expressions and statements to further improve student understanding, providing additional help for catch up as seen in above examples from the audio and video recordings. The researcher coded these kinds of statements as Individual Instruction.

In sum, twelve types of interactions were used to investigate the nature and quality of the teacher-student interactions. Each interaction was categorized into two different groups looking into the nature and quality of the teacher-student interactions. Each group also has multiple dimensions as to better explain the variations of the teacher-student interactions in the classroom.

The first group is the nature of the interaction and it includes three dimensions: positive, negative and neutral. The positive interaction dimension includes: positive comment (PC), praise (PE), individual instruction (II), open-ended question (OQ), scaffolding questions (SQ) and clarifying (CL). The negative interaction dimension includes: negative comment (NC), disciplinary/warning comment (DWC), minimal or no comment (MC). The neutral interaction dimension includes: closed questions (CQ), restating (RS) and directive comment (DC).

The second group is the quality of the teacher student interactions and has two dimensions; high quality interactions and moderate quality interactions. The high quality interactions dimension includes: open-ended question (OQ), scaffolding questions (SQ), praise (PE), individual instruction (II), and clarifying (CL) and the moderate quality interactions dimension includes: positive comment (PC), negative comment (NC), disciplinary/warning
comment (DWC), minimal or no comment (MC), closed questions (CQ), restating (RS) and directive comment (DC).

Each teacher-student interaction that took place during the science lessons were coded into the appropriate categories, groups and dimensions for each individual student. Having completed the coding of interactions for each category, the frequencies, means and standard deviations of teacher student interactions within each group and dimension were computed. The descriptive statistics for 12 teacher-student interaction categories were reported in Table 4.2.

Table 4.2

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<td>22</td>
<td>2</td>
<td>24</td>
<td>9.82</td>
<td>5.626</td>
<td>167</td>
</tr>
<tr>
<td>CQ</td>
<td>17</td>
<td>25</td>
<td>3</td>
<td>28</td>
<td>14.29</td>
<td>6.734</td>
<td>243</td>
</tr>
<tr>
<td>OQ</td>
<td>16</td>
<td>18</td>
<td>3</td>
<td>21</td>
<td>7.50</td>
<td>4.561</td>
<td>120</td>
</tr>
<tr>
<td>SQ</td>
<td>13</td>
<td>8</td>
<td>1</td>
<td>9</td>
<td>2.85</td>
<td>2.304</td>
<td>37</td>
</tr>
<tr>
<td>MC</td>
<td>8</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>2.38</td>
<td>1.768</td>
<td>19</td>
</tr>
<tr>
<td>NC</td>
<td>17</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>2.47</td>
<td>1.736</td>
<td>42</td>
</tr>
<tr>
<td>DC</td>
<td>17</td>
<td>15</td>
<td>3</td>
<td>18</td>
<td>10.41</td>
<td>4.757</td>
<td>177</td>
</tr>
<tr>
<td>RS</td>
<td>16</td>
<td>8</td>
<td>1</td>
<td>9</td>
<td>3.81</td>
<td>2.482</td>
<td>61</td>
</tr>
<tr>
<td>CL</td>
<td>15</td>
<td>7</td>
<td>1</td>
<td>8</td>
<td>3.87</td>
<td>2.386</td>
<td>58</td>
</tr>
<tr>
<td>DWC</td>
<td>15</td>
<td>13</td>
<td>1</td>
<td>14</td>
<td>4.73</td>
<td>3.173</td>
<td>71</td>
</tr>
<tr>
<td>II</td>
<td>16</td>
<td>6</td>
<td>1</td>
<td>7</td>
<td>2.87</td>
<td>1.857</td>
<td>46</td>
</tr>
</tbody>
</table>

The descriptive statistics looking into the two interaction groups included the dimensions of nature of interaction, and quality of interaction.
The nature of teacher-student interaction group included three dimensions that are positive interaction, negative interaction, and neutral interaction. The frequencies are reported in Table 4.3 along with means and standard deviations for each dimension of nature of interaction group.

Table 4.3

Descriptive Statistics for Teacher-Child Interaction by Nature of Interaction

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
<th>Total Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI_Positive*</td>
<td>17</td>
<td>48</td>
<td>5</td>
<td>53</td>
<td>26.71</td>
<td>13.298</td>
<td>454</td>
</tr>
<tr>
<td>NI_Negative**</td>
<td>17</td>
<td>17</td>
<td>2</td>
<td>19</td>
<td>7.76</td>
<td>5.093</td>
<td>132</td>
</tr>
<tr>
<td>NI_Neutral***</td>
<td>17</td>
<td>48</td>
<td>7</td>
<td>55</td>
<td>28.29</td>
<td>12.139</td>
<td>481</td>
</tr>
</tbody>
</table>

The quality of teacher-student interaction group included two dimensions: high quality interaction and moderate quality interaction. The frequencies are reported in Table 4.4 along with means and standard deviations for each dimension of quality of interaction group.

Table 4.4

Descriptive Statistics for Teacher-Child Interaction by Quality of Interaction

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
<th>Total Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>QI_High</td>
<td>17</td>
<td>34</td>
<td>3</td>
<td>37</td>
<td>16.88</td>
<td>9.185</td>
<td>287</td>
</tr>
<tr>
<td>QI_Moderate</td>
<td>17</td>
<td>67</td>
<td>14</td>
<td>81</td>
<td>45.88</td>
<td>18.350</td>
<td>780</td>
</tr>
</tbody>
</table>
The descriptive statistics indicated that the classroom has higher means in “Closed Question” (=14.29), and “Directive Command” (= 10.41) and lower means in “Praise” (= 2.00), “Scaffolding Questions” (= 2.85), “Minimal Comment” (= 2.38), “Negative Comment” (= 2.47), “Individual Instruction” (= 2.87). The class has also lower mean in “Negative Interaction” (=7.76) and has higher means in “Neutral Interaction” (=28.29) and “Positive Interaction” (=26.71) considering the nature of interaction group. The descriptive statistics also indicated that the classroom has higher mean in “Moderate Quality Interaction” (= 45.88), and lower mean in “High Quality Interaction” (=16.88), considering the nature of interaction dimension.

**Is There a Relationship between Teacher-Child Interaction and Teacher-Child Relationship?**

The Student-Teacher Relationship Scale (STRS) (Pianta, 2001) was used to assess the quality of teacher-student relationships. The STRS is designed to assess teachers' perceptions of their relationship with their students and is widely used in studies looking for teacher student relationships in early elementary grades. The STRS consist of three dimensions measuring the quality of relationships; closeness, conflict, and dependency. Descriptive statistics were computed for each of the three Teacher Student Relationship Scale (STRS) subscales (Conflict, Closeness, and Dependency) and also for the total STRS score (Table 4.5). The descriptive statistics for the STRS indicates a range of 25 and the standard deviation is calculated as 6.508. Compared to the other two subscales of Conflict and Dependency, there is relatively high range (= 14.00) and standard deviation on the subscale Closeness (= 4.704). The range for the Conflict and Dependency subscales were 9.00 and 2, and the standard deviation for the two subscales were calculated as 2.201 and .712 respectively.
The teacher student interactions included twelve interaction categories that were used to explain the nature and the quality of teacher-student interactions. Pearson Product Moment correlations between teacher-child interaction (nature of interaction and quality of interaction) and teacher-child relationship (Conflict, Closeness, Dependency) were computed to explore the possible relationships. The results are first presented by Nature of Interaction (positive interaction, negative interaction and neutral interaction) dimensions (Table 4.6) and then by Quality of Interaction (high quality interaction and moderate quality of interaction) dimensions (Table 4.7).

The results showed that there was significant correlation between the STRS scores of the students and the total nature of interaction scores of the students at 0.05 alpha level (r = .553, p<.05). Nature of interaction group consisted of three dimensions and the correlations between each dimension and students’ total STRS score is also reported. There was significant correlation between the students’ total STRS score and the nature of interaction dimension “Positive Interaction” (r = .491, p<.05). There was also significant correlation between the students’ total STRS score and the nature of interaction dimension “Neutral Interaction” (r = .514, p<.05).
However, there was no significant correlation between the students’ total STRS score and the nature of interaction dimension “Negative Interaction” (r = .359, p<.05).

The STRS consists of three dimensions measuring the quality of relationships; closeness, conflict, and dependency and the correlation coefficients were computed between each of the STRS dimensions and the total nature of interaction score, and three dimensions of the nature of interaction (positive, negative, neutral). There was significant correlation between the STRS subscale Closeness and the total nature of interaction (r = .511, p<.05). There was also significant correlation between the STRS subscale Closeness and the nature of interaction dimension “Negative Interaction” (r = .493, p<.05). However, there was no significant correlation between the STRS subscale Closeness and the two dimensions of the nature of interaction “Neutral Interaction” (r = .449, p<.05) and “Positive Interaction” (r = .416, p<.05). The data revealed that the STRS subscale Conflict was not significantly correlated with the total nature of interaction (r = .425) and there was also no significant correlation between the STRS subscale Conflict and any of the nature of interaction dimensions “Positive Interaction” (r = .396), “Negative Interaction” (r = .079) and “Neutral Interaction” (r = .457). There was no significant correlation between the STRS subscale Dependency and the total nature of interaction (r = .367). The STRS subscale Dependency was only significantly correlated with the nature of interaction dimension “Positive Interaction” (r = .521, p<.05). There was no significant correlation between the STRS subscale Dependency and the two other nature of interaction dimensions “Negative Interaction” (r = -.218) and “Neutral Interaction” (r = .318). The correlation coefficients between teacher-child relationships (Conflict, Closeness, and Dependency) and the nature of teacher-child interactions are reported in Table 4.6.
Table 4.6  

**Nature of Interaction – Teacher-Student Relationship Correlation**

<table>
<thead>
<tr>
<th>Nature of Interactions</th>
<th>Teacher-Student Relationships</th>
<th>Nature of Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conflict</td>
<td>Closeness</td>
</tr>
<tr>
<td>Conflict</td>
<td>Pearson Correlation 1</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.567*</td>
<td>.418</td>
</tr>
<tr>
<td>Closeness</td>
<td>Pearson Correlation .600*</td>
<td>Sig. (2-tailed) .018</td>
</tr>
<tr>
<td>Dependency</td>
<td>Pearson Correlation .111</td>
<td>Sig. (2-tailed) .473</td>
</tr>
<tr>
<td>Total STRS</td>
<td>Pearson Correlation .396</td>
<td>Sig. (2-tailed) .011</td>
</tr>
<tr>
<td>Positive</td>
<td>Pearson Correlation .079</td>
<td>Sig. (2-tailed) .653</td>
</tr>
<tr>
<td>Negative</td>
<td>Pearson Correlation .425</td>
<td>Sig. (2-tailed) .148</td>
</tr>
<tr>
<td>Neutral</td>
<td>Pearson Correlation .425</td>
<td>Sig. (2-tailed) .148</td>
</tr>
<tr>
<td>Total Interaction</td>
<td>Pearson Correlation .396</td>
<td>Sig. (2-tailed) .011</td>
</tr>
</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).
The results showed that there was significant correlation between the STRS scores of the students and the total quality of interaction scores of the students ($r = .553, p<.05$). Quality of interaction group consisted of two dimensions and the correlations between each dimension and students’ total STRS score is also reported. There was significant correlation between the students’ total STRS score and the two quality of interaction dimensions “High Quality Interaction” ($r = .496, p<.05$) and “Moderate Quality Interaction” ($r = .547, p<.05$). There was no significant correlation between the ethnicity ($r = .714, p>.05$) and gender ($r = .378, p>.05$) of the students and the teacher’s perception of the relationship with the students. There was also no significant correlation between the ethnicity ($r = .774, p>.05$) and gender ($r = .064, p>.05$) of the students and the total number of teacher-student interactions. There were significant correlation between the STRS subscale Closeness and the total Quality of Interaction ($r = .511, p<.05$). There was also significant correlation between the STRS subscale Closeness and the quality of interaction dimension “Moderate Quality Interaction” ($r = .509, p<.05$). However, there was no significant correlation between the STRS subscale Closeness and the quality of interaction dimensions “High Quality Interaction” ($r = .451$). Similar to the results reported for nature of interaction, STRS subscale Conflict was not significantly correlated with the total quality of interaction ($r = .425$). There was also no significant correlation between the STRS subscale Conflict and any of the quality of interaction dimensions “High Quality Interaction” ($r = .351$), “Moderate Quality Interaction” ($r = .436$). The STRS subscale Dependency was not significantly correlated with the total quality of interaction ($r = .367$) and any of its two dimensions “High Quality Interaction” ($r = .470$) and “Moderate Quality Interaction” ($r = .293$). The correlation coefficients between teacher-child relationships (Conflict, Closeness, and Dependency) and the quality of teacher-child interactions are reported in Table 4.7.
Table 4.7

*Quality of Interaction – Teacher-Student Relationship Correlation*

<table>
<thead>
<tr>
<th></th>
<th>Teacher-Student Relationships</th>
<th>Quality of Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conflict</td>
<td>Closeness</td>
</tr>
<tr>
<td>Conflict</td>
<td>Pearson Correlation</td>
<td>.567*</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.018</td>
</tr>
<tr>
<td>Closeness</td>
<td>Pearson Correlation</td>
<td>.567*</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.018</td>
</tr>
<tr>
<td>Dependency</td>
<td>Pearson Correlation</td>
<td>.567*</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.018</td>
</tr>
<tr>
<td>Total STRS</td>
<td>Pearson Correlation</td>
<td>.567*</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.018</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).
Is There a Relationship between Teacher-Child Interaction and Third-Grade Students’ Conceptual Understanding of Science?

Conceptual science understanding scores were obtained through a unit test, which was administered to the students as pre- and post-tests at the beginning and end of a new science unit. The unit test was given to the participants before the unit started and the Cronbach’s alpha for the unit test was calculated as .704. Student gain scores were computed after the analysis of the post-test scores and respective descriptive statistics were summarized in Table 4.8.

Table 4.8

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test Score</td>
<td>17</td>
<td>19</td>
<td>14</td>
<td>33</td>
<td>22.53</td>
<td>4.875</td>
</tr>
<tr>
<td>Post-test Score</td>
<td>17</td>
<td>10</td>
<td>29</td>
<td>39</td>
<td>35.47</td>
<td>2.528</td>
</tr>
</tbody>
</table>

The results indicate that students’ conceptual understanding related to specific science unit improved during the science lessons. The mean score of the students were 22.53 for the pre-test and it increased to 35.47 for the post-test. The gap between high and low achieving students’ conceptual understanding scores declined through the science unit and respective standard deviation scores were reported as 4.875 and 2.528 for the pre- and post-test. Decrease in the range of the scores from 19 to 10 for the pre-test and the post-test also reflects a positive improvement for all the students even for those who received lower scores from the pre-test. Minimum student score for the unit test increased from 14 to 29 and showed a steady progress in student learning during the instruction of the science unit. There were no significant correlation
between the ethnicity (.357, p>.05) and gender (.467, p>.05) of the students and the student gain scores.

Pearson Product Moment correlations were computed to investigate any relationship between teacher-child interactions and students’ conceptual understanding of science. Teacher-child interactions were classified into twelve categories, which were separated into five dimensions and two groups. Nature of interaction group included three dimensions as positive, negative and neutral interaction and quality of interaction group included high and moderate interaction dimensions. The results are first presented by Nature of Interaction group and its three dimensions (Table 4.9). Correlations between quality of interaction group including its two dimensions and students’ conceptual understanding of science were presented in Table 4.10.

The statistical analysis of the data revealed that there were no significant correlation between the students’ conceptual science understanding scores and the nature of interaction group (r = .160, p >.05). The similar results were observed for all three dimensions of the nature of interaction group. Students’ conceptual understanding of science scores were not significantly correlated with positive interaction dimension (r = .252, p >.05); negative interaction dimension (r = .057, p >.05); neutral interaction dimension (r = .049, p >.05). The correlation coefficients between students’ conceptual understanding of science and nature of teacher-child interaction and its three dimensions (Positive, Negative, and Neutral) are reported in Table 4.9.

There were no significant correlation between the students’ conceptual understanding of science and the quality of interaction group (r = .160, p >.05). The two dimensions of the quality of interaction group did not show any significant correlation with the students’ conceptual understanding of science and the results were (r = .086, p >.05) and (r = .188, p >.05) for “High Quality Interaction” and “Moderate Quality Interaction” respectively. The correlation
coefficients between students’ conceptual understanding of science and quality of teacher-child interaction and its two dimensions (High and moderate quality interaction) were reported in Table 4.10.

**Is There a Relationship between Teacher-Child Relationship and Third-Grade Students’ Conceptual Understanding of Science?**

The correlation between teacher-child relationship and students’ conceptual understanding of science was investigated and Pearson Product Moment Correlations were computed. Students were rated by their teachers using the STRS in order to obtain teacher child relationship scores. STRS included three subscales that are Conflict, Closeness, and Dependency and the correlations are presented as the three STRS subscales and the total STRS score. Analyses of the data revealed that there was no significant correlation found between the students’ conceptual understanding of science and the teacher-child relationship for the total STRS score ($r = .297, p > .05$). The similar results were observed for all three subscales of STRS. For the current study, students’ conceptual understanding of science were not significantly correlated with any of the three STRS subscales; Closeness ($r = .246, p > .05$); Conflict ($r = .322, p > .05$); Dependency ($r = .094, p > .05$). The correlation coefficients between students’ conceptual understanding of science and the teacher-child relationship as total STRS score and its three subscale scores were reported in Table 4.11.
Table 4.9

*Correlations between the Nature of Interaction and Students’ Conceptual Understanding of Science*

<table>
<thead>
<tr>
<th></th>
<th>Nature of Interaction</th>
<th></th>
<th>Student Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
<td>Neutral</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>Pearson Correlation</td>
<td>.395</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>Pearson Correlation</td>
<td>.664**</td>
<td>.639**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.004</td>
<td>.006</td>
</tr>
<tr>
<td>Total Interaction</td>
<td>Pearson Correlation</td>
<td>.885**</td>
<td>.686**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.002</td>
</tr>
<tr>
<td>Post-test Score</td>
<td>Pearson Correlation</td>
<td>.404</td>
<td>-.403</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.108</td>
<td>.108</td>
</tr>
<tr>
<td>Gain Score</td>
<td>Pearson Correlation</td>
<td>.252</td>
<td>.057</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.329</td>
<td>.828</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).
Table 4.10

Correlations between the Quality of Interaction and Students’ Conceptual Understanding of Science

<table>
<thead>
<tr>
<th></th>
<th>Quality of Interaction</th>
<th>Student Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.818**</td>
<td>.000</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.917**</td>
<td>.980**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Total Interaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.231</td>
<td>-.042</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.372</td>
<td>.873</td>
</tr>
<tr>
<td>Post-test Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.086</td>
<td>.188</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.743</td>
<td>.471</td>
</tr>
</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).
Table 4.11

*Correlations between Conceptual Science Understanding Scores and the STRS*

<table>
<thead>
<tr>
<th></th>
<th>Teacher-Student Relationships</th>
<th>Student Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conflict</td>
<td>Closeness</td>
</tr>
<tr>
<td>Conflict</td>
<td>Pearson Correlation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>1</td>
</tr>
<tr>
<td>Closeness</td>
<td>Pearson Correlation</td>
<td>.567*</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.018</td>
</tr>
<tr>
<td>Dependency</td>
<td>Pearson Correlation</td>
<td>.600*</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.011</td>
</tr>
<tr>
<td>Total STRS</td>
<td>Pearson Correlation</td>
<td>.814**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
</tr>
<tr>
<td>Post-test Score</td>
<td>Pearson Correlation</td>
<td>.052</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.842</td>
</tr>
<tr>
<td>Gain Score</td>
<td>Pearson Correlation</td>
<td>.322</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.208</td>
</tr>
</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed)
CHAPTER 5

DISCUSSION

Children’s learning and intellectual functioning in the classroom and outside is strongly related to the social interaction and relationships in which they are embedded (Cazden, 2001). Research on student learning and achievement suggests that social interaction in general and classroom interaction in particular has significant effects on children’s learning and cognitive development (Mercer & Littleton, 2007).

Elementary school children spend most of their time at school in one classroom interacting with their teachers and with their classmates. Thus, enhancing the quality of their interactions and relationships with their teachers may provide the means for creating a positive classroom environment and a more desirable social atmosphere that is necessary for increased student motivation and interest in learning. Teachers are expected to establish positive relationships with their students in order to accomplish better student outcomes. Teacher-student interactions and classroom talk provide opportunities for teachers to learn more about their students and in return by facilitating positive and supportive classroom interactions, teachers may provide opportunities for their students to improve their academic outcomes. The research suggests that students with positive, caring and quality relationships with their teachers experience fewer problems at school and put more effort toward meeting their teachers’ expectations.

Discussion of Research Findings

The purpose of the current study was to explore the nature and quality of teacher-student interactions in an elementary school classroom and to investigate its connections to teacher-student relationships and student learning. The study sought to determine the nature and quality
of the teacher student-interactions that take place during third grade elementary science lessons and investigated any links among the teacher-student interactions that take place in the classroom, teacher’s perception of the teacher-student relationship, and the students’ conceptual understanding of science. This chapter discusses the findings of the study for each research question and provides information on its relation to existing literature and proposes educational implications and explanations in relation to the theory. Lastly, limitations of the current study and suggestions for future research are discussed.

**Nature and Quality of Teacher-Child Interactions during Science Lessons**

The researcher utilized and used twelve types of interaction categories in order to investigate the nature and quality of the teacher-child interactions that take place during classroom talk. The interaction types that were used in coding included Closed Question, Open-ended Question, Scaffolding Questions, Clarifying, Restating, Praise, Positive Comment, Negative Comment, Directive Comment, Disciplinary/Warning Comment, Minimal or No Comment, and Individual Instruction. Each interaction was initially categorized into two different groups looking into the nature and quality of the teacher-student interactions. Each group had multiple dimensions as to better explain the variations of the teacher-student interactions in the classroom. The first group of interactions looked into the nature of the teacher-student interactions and had three dimensions: positive, negative and neutral. The second group looked into the quality of the teacher-student interactions and had two dimensions to it: higher quality interactions and moderate quality interactions.

The results of the study revealed that the teacher utilized classroom talk in several ways to generate student interest to the topic and to provide opportunities for students to share their ideas. Similarly, the teacher also used classroom talk to lead students in a certain direction or to
control and discipline some students hindering the steady progress of the lesson. The twelve
types of teacher-student interaction categories were very effective in capturing all the teacher
expressions and statements that took place during the lessons which the teacher aimed to
diagnose student understanding, explore and extend student ideas, clarify comments, provide
feedback, express approval or dissatisfiedment, request certain behavior, establish rules, express
frustration, provide additional help and other assistance.

Teachers constantly look for methods and utilize different strategies to increase student
interest in learning and teacher questions are one of the primary tools used in instruction. Among
all twelve interaction types, closed questions in particular were one of the most employed ways
of interaction type used between the teacher and the students. Wood (1992) discussed teachers’
extensive and ineffective use of questions and claimed that most teachers use questions (e.g.
closed questions) just to get one brief answer. Student responses were usually a repetition of
teachers' earlier statements and often lacked the purpose of generating student interest in the
topic. Therefore, answers are more of a reiteration of information for children and they are
suppressed to make any contribution to the teaching and learning through talk.

The current study provided similar results to some extent. The classroom teacher
primarily used closed questions that required short answers and utilized student responses to
align the instruction to the objectives of the lesson. Rather than expecting in-depth information
from the student responses, closed questions aimed to start a conversation to evoke student
interest to the part of the topic that still needed to be addressed, or to re-emphasize and recall
information that has already been covered. The following is a part of the classroom conversation
obtained from the transcriptions including closed questions:
Teacher: If I am here in Florida and it is daytime. So I am kind of in the Sun’s direction. Way across on the other side of the world and we can get the globe for that. We will put it on Gia’s desk. Is that okay? Alright. If I am here and Gia is the Sun. Whooaa. Just shining down, look at all that light coming from her. Way over here and let’s say India. Is the Sun shining on it?

Students: Nooo

Teacher: It is over here, right here? Is the Sun shining?

Students: No, it is not.

Teacher: Did the Sun go away? Is it gone forever?

Students: Nooo

Teacher: Do you ever think India is going to see the Sun and feel the raise of it?

Students: Yesss

Teacher: Do you think it is when the earth starts to turn and get toward that side of the Sun.

Students: Yes.

The teacher used closed questions as an essential part of the classroom instruction. She utilized closed questions quite often to increase student participation by asking questions to different students in the classroom regardless of their willingness to take a part in classroom
discussion. It seemed to be an effective way to increase student interest in the topic especially for those who were not paying much attention to the lesson. Most questions required short answers and the teacher used the answers to help students recall information, to give feedback or to further elaborate on the topic. The teacher did not use the closed questions as a way to test student knowledge for a grade but used student answers to correct any misunderstandings and to expand student information. The teacher was not judgmental about student answers being right or wrong and this approach seemed to have increased student participation in the classroom talk. Teacher questions were aligned with the lesson objectives and curriculum goals in order to guide students to the desired level of understanding of the topic. Thus, the teacher was able to draw student attention to any important parts of the lesson that still needed to be elaborated upon and the overall pace of the instruction was influenced by the quantity of the questions asked by the teacher. Although the teacher seemed to be trying to address questions evenly among the students in the classroom, those students who are socially more interactive and academically more advanced tended to answer more of the teacher’s questions. However, students who seemed to be shy or less socially interactive tended to stay quiet during the classroom interaction, and they often waited for the teacher to ask for their answers instead of voluntarily raising hands to express their ideas.

Even though it did not seem to be the preference or intent of the teacher to provide fewer opportunities for the less interactive students, it aligns with the literature that some students are not given equal opportunities to answer their teacher’s questions. Wang (1991) and Wood (1992) stated that teachers tend to call on lower ability students less often and provide fewer opportunities for them to interact. Lower ability students usually do not get the same opportunity as their more able peers to answer teacher questions. They are given less time to respond to
questions and they are provided limited feedback. Teachers often interact in a more controlling tone with the less able students. Conversations are mostly built around teacher questions and rapid corrections. This type of interaction causes lower ability students to initiate conversations less and create hesitation for them to participate and contribute to classroom discussions.

The findings of the study suggest that students’ willingness to participate in the classroom talk seemed to be related to the number of interactions students were involved in with their teacher. Socially less interactive students tended to receive fewer teacher questions than their socially high interactive classmates. Arguably, it could also be claimed that higher ability students are more likely to be avoided and ignored by the teacher when it comes to answering the teacher’s questions and participating in classroom talk in order to provide more opportunities for their less socially interactive or lower ability classmates. Lower ability or less socially interactive students are less likely to be ignored or avoided by the teacher during classroom talk as the teacher looks for opportunities to reach each and every child in the classroom, especially to those that require more academic support.

For the current study, the teacher usually asked closed questions that only required a brief answer. The questions were usually structured to attract students’ attention to a certain part of the lesson, or specific content, and to guide them towards a certain understanding. When a student’s answer was incorrect, the teacher usually asked other students comment on their classmate’s answer or she directed the question to another student to ask for his/her ideas in order to help students establish a more coherent conceptual understanding of the topic as a whole class.

In addition to the closed questions, the teacher also used open-ended and scaffolding questions to extend student ideas and to guide students to a desired level of understanding. Open questions were usually utilized when the teacher wanted the students to develop an in-depth
understanding of a concept or to address any student misunderstandings. Answers usually
required higher-order thinking and students were given a chance to express their reasoning
behind their answers in detail. As the student answers varied in length and detail, at times the
teacher used additional scaffolding questions to open up the answer and tried to build up a
conversation to elaborate student ideas. The teacher seemed to be using open-ended and
scaffolding questions to accomplish the objectives of the lesson while increasing the students’
awareness of their understanding of the topic. The teacher did not seem to be valuing one
question type over another as long as they serve towards the learning goals regardless of the
questions as being closed, open ended or scaffolding. However, it is clear from the results of the
study that the teacher preferred closed questions over open-ended questions and used them more
often in the classroom. Scaffolding questions were only used when the teacher wanted to guide
students towards a structured understanding of the topic by drawing new questions upon their
responses.

Questions in general tended to be the classroom teacher’s most preferred way of
interaction in order to create a shared experience for the students and to improve student
understanding. The teacher used student answers as a feedback to determine any student
weaknesses and to generate more questions to further elaborate student ideas. This is consistent
with the literature that good teacher questions can influence students’ learning in a positive way.
A teacher can stimulate student thinking and press for understanding of the scientific phenomena
by asking good questions and guiding students’ thoughts to make connections with their prior
knowledge. Asking children for different examples, and having others comment on each other’s
thoughts, give teachers an insight about student understanding and allows teachers to tailor those
conceptions to the right path (McCartney, 1984; Newton, 2002).
The current study revealed that the directive comments were one of the most utilized ways of teacher-student interactions in the classroom. The teacher used directive comments to request a certain behavior from the students while guiding them through a classroom activity. Such directive comments usually took place as part of the instruction and required a student to do a particular task such as opening a page in the book, reading aloud for the classroom, or standing up to pretend as the moon against the sun for classroom presentation. Following is an example of the teacher’s use of directive comments as parts of the instruction:

Teacher: Let’s start it up. She’s talking more about the revolution, and then I’ll show you the animation. Ok? James, will you start to read first paragraph nice and loud.

James: [reads the first paragraph]

Teacher: Keep reading a little bit louder.

The teacher’s use of directive comments was not always directly related to the topic that was being taught. The teacher also used directive comments to organize and manage the classroom environment. Teacher commands involved the use of statements to enforce classroom rules and to establish certain norms. Following is an example of the teacher’s use of directive comments requesting a certain behavior from the student that is not directly related to the content being taught:

Teacher: Exactly, that’s how I feel. But if you could, make sure your desks are cleaned up, nothing on top, nothing on the bottom. You may also very quickly, quietly stack up your chairs.

Students: [Murmuring]
Teacher: And stay at your desk.

The findings of this research revealed that positive comments were another teacher-student interaction type observed during the classroom talk. The teacher used positive comments generously during the instruction to increase student interest in the topic and attract other’s attention to a particular point of the lesson. The teacher encouraged students to express their current state of understanding and rewarded students for sharing their ideas, and this seemed to increase student motivation in learning. The students appeared to be well aware of their teacher’s positive reaction to their responses and freely expressed their thoughts during the discussions. The teacher appeared to be enthusiastic about providing opportunities for all the students to share their ideas regardless of the student’s achievement or knowledge level. Receiving positive comments for a correct answer or any reproductive addition to the classroom discussion seemed to function well in terms of increasing student’s willingness to explicit their thoughts without any fear. The following is an example of teacher’s effort to encourage students to share their ideas obtained from the transcriptions of the observations:

Teacher: Go for it. You can tell us what you think Ethan. Don’t be shy.

The classroom teacher was very careful about not criticizing the students for their incorrect answers to the questions. The teacher appeared to be quite successful about shifting the question from one student to another until the correct response is received and the whole classroom reached a shared understanding of the concept.

The findings of the study suggested that any extra student effort to explain a contradiction and to resolve a problem was rewarded by praise from the teacher. The praises aimed for the recognition of the accomplishment of the student by his/her classmates and often followed a request for congratulating gesture from the whole class. The teacher’s use of positive comments
and praises appeared to be an integral part of her effort to create a productive learning environment and seemed to be effective in increasing student enthusiasm and participation. The literature rightfully stresses the importance of a teacher’s responsibility for creating a friendly classroom environment where students can experience the joy of participating in activities and figuring out solutions to the problems. A teachers’ main responsibility is to motivate and encourage students to seek answers to the problems and to work toward understanding new concepts (Cobb, 1988; von Glasersfeld, 1993). Classroom interaction may help children move forward in their conceptual understanding, and teachers can stimulate this process by encouraging their students to actively participate. Encouraging students to reflect upon each other’s thoughts and share their reasoning could improve their understanding (Alexander, 2011).

The results of the current study did not align with some of the studies looking into race and gender as a factor in teacher’s use of praise in teacher-student interactions. Casteel (1998) examined teacher-student interactions and differences in teacher treatment between African American and Caucasian students in middle school students. The results of the study suggested that African American students received significantly less praise from their teachers than their Caucasian classmates. Similarly, teachers praised boys over girls more often and, among boys, African American boys received less praise than all other students. Skolnick et al. (1982) reported that teachers favor boys over girls in their teaching practices and praised boys more often for their intellectual ability to produce a quality work whereas girls receive more praise for their neatness rather than their intellectual work. For the current study no differences were observed in teacher’s use of positive comments and praise in regards to the students’ race or gender.
The findings of the study revealed that the classroom teacher restated student answers and comments to attract students’ attention to the shared information. The teacher also used restating to emphasize the importance of information that needs to be learned by the students. The teacher chose to interact with the students in different ways depending on the progress of the conversation with the students. If the student answer was correct, the teacher either followed up with an additional question or skipped to the next point in the lesson after restating the student’s answer. Other times, the teacher preferred to further elaborate on the student’s answer and offered clarifications by explaining facts and providing detailed feedback on the answer.

Clarifying comments were usually lengthy and included several sentences served as building blocks for a thorough understanding of the concept for all students in the classroom. The teacher utilized individual instruction when a student seemed to fall behind of his/her peers in terms of making sense of a concept and she aimed to provide additional help for the students catch up with the instruction. The teacher appeared to determine the students who needed individual instruction by evaluating their answers to the questions and their level of participation in the classroom discussions. Additional clarifying comments were used to address any contradictions in student understanding and aimed to make clear explanations of the concept for the whole class. If the teacher’s clarification was not enough for a particular student to understand the lesson, she usually provided supplementary help for the student while others were working on another task. Lower achieving students seemed to receive more individual instruction from their teachers and were checked regularly by their teacher for a thorough understanding of the concept.

Classroom interaction involved a wide range of teacher-student conversations including disciplinary/warning comment, minimal/no comments and negative comments to maintain a
more respectful and productive learning environment. Along with minimal/no comments and negative comments, disciplinary/warning comments served as a tool for the teacher to express dissatisfaction and to enforce certain behaviors. Boys in the classroom were observed to receive more disciplinary/warning comments from their teacher. In contrast, girls seemed to experience fewer disciplinary problems with their teacher and received fewer warnings. The teacher seemed to be more cautious about the behaviors of the boys and wanted the warnings to be recognized by the whole class as to protect and enforce the classroom rules. These findings are consistent with some previous research suggesting that boys receive behavioral management from their teachers more frequently than girls. The literature suggests that girls tend to establish more supportive ties and closer relationships with their teacher than boys do during the early years of schooling (Birch & Ladd, 1997; Dweck et al., 1978; Hall & Sandler, 1982; Taylor & Machida, 1996).

Additionally, boys are more likely to experience conflict in their relationships with their teachers (Birch & Ladd, 1997, 1998; Hamre & Pianta, 2001; Kesner, 2000; Stuhlman & Pianta, 2002) and their misbehavior is taken more seriously than that of girls (Borg & Falzon, 1993).

The results from the current study revealed that the classroom teacher interacted with the children in the context of the classroom instruction and sought to maintain a pleasing learning environment for all of the students. The interactions did not seem to be approached as positive, negative or neutral but utilized as necessary to accomplish the objectives of the lesson and the goals of the curriculum. The results of the study suggested that teacher-student interactions during the science lessons were mostly neutral in nature and included the interaction types of closed questions, restating and directive comments. The teacher’s use of closed questions and restating to monitor the progress of the lesson and utilizing directive comments to request a certain behavior seemed to be the reason for higher number of neutral teacher-student
interactions observed in the classroom. Positive teacher-student interactions were also observed as much as the neutral interactions, but they seemed to serve a higher purpose than merely being used as a tool to coordinate the instruction to a particular direction. The classroom teacher initiated positive interaction types like positive comment and praise to increase student interest to the topic and encourage students’ participation in their learning. Establishing supportive ties and trust with the children allowed the teacher to effectively utilize other positive teacher-student interaction types (e.g., open questions, scaffolding questions, individual instruction and clarifying comments) in the classroom. The students tended to show no hesitation in sharing their ideas and appeared to ask for additional help from the teacher as they felt necessary. Positive teacher-student interactions were observed to be effective for the teacher to determine the students’ level of understanding of the concept, and to make any adjustments to the teaching as necessary. This finding is also supported by the literature that positive teacher-student interactions and classroom talk provide opportunities for teachers to learn more about their students and, in turn, by facilitating positive and supportive classroom interactions, teachers’ may help their students to accomplish better academic outcomes (Fosnot, 2005; Lambert & McCombs, 1998). The teacher was observed to get involved in negative teacher-student interactions (i.e., disciplinary/warning comment, negative and minimal comment) when classroom management became an issue. Students’ breaking the classroom rules and presenting a disruptive behavior usually resulted in teacher warning. Negative teacher-student interactions accounted for about ten percent of the interactions in the classroom. The classroom teacher was observed to make a strong effort toward a more open and risk-taking learning environment while maintaining a disciplined learning atmosphere for all the students. Hamre and Pianta (2005) suggested that teachers who create and maintain a positive relationship with students are more
likely to utilize effective teaching strategies. They are also more successful in establishing necessary norms for effective classroom management. For the current study, the classroom teacher appeared to be resourceful in engaging students in the classroom activities and the students were observed to enjoy sharing their ideas with their classmates. Both Piaget and Vygotsky believed in the important role of classroom interaction in learning and cognitive development. Social interaction is at the core of the developmental process and children’s interaction with their peers and teachers have an impact on their learning (Mercer & Littleton, 2007). The teacher was observed to be effective in structuring the class time and created some opportunities for small group and whole class discussions during the instruction of the science unit. Following is an example of teacher’s effort for encouraging peer interaction by constructing small groups:

Teacher: Ok. How about working in groups? You only do it with seven math facts and then you guys switch. And then a new person holds the cards and then one of the old people, you’re going to stay and try to answer and the card person will switch to that. Does that make sense?

Students: Yeah.

Teacher: Ok. Do about seven facts and then switch. That way everyone in the group will have a chance to hold the cards and have a chance to practice. We’re good?

Teacher: James, Lily, Ida. Hey look at how I’m making your groups. It’s the people you sit with. I am too smart. You can find a cosy spot in the classroom. Ok? Push in your chairs. Make sure you’re ready. You three
are here. That’s your group. Go find a spot. You three boys (pointing Connor, AJ, and Tommy). You three girls (pointing Ian, Chloe, and Dennis) Perfect. Adam, you can pick your group to join. Ok. Any group you like. Or actually Adam, can you do me a favor? Can you join Ida and Lily’s group? Cos they need a third member. Will you do that? And that works out perfectly for us.

Quality teacher-student interactions are considered to be essential for effective classroom instruction and for improved student learning. The current study approached the quality of the interaction types in regards to their connectedness and support for the higher-order thinking of the students. High quality interactions (i.e., open-ended questions, scaffolding questions, praise, individual instruction, and clarifying comments) aimed to improve students’ cognitive understanding while seeking for increased sense of student engagement, interest, and achievement. The majority of the teacher-student interactions in the science classroom were observed to be more moderate in quality than high. This could be related to the additional instructional time needed for high quality interactions which often require why questions, clarifications, feedback, and asking for underlying thoughts. The classroom teacher was observed to be engaging in high quality interactions depending on the importance of the concept and students’ level of understanding. Students were provided opportunities to share their reasoning as the class time allowed. The teacher used open questions to initiate higher-order thinking. Student answers were followed up with additional questions to point out any contradictions in student reasoning and requested elaboration from the students. The teacher also provided in-depth feedback and offered clarification for any student misunderstanding. Accomplishing the objectives of the lesson and the goals of the curriculum in a timely manner seemed to be the
limiting factor on teacher’s use of high quality interactions. The teacher was observed to welcome student ideas to reveal their natural curiosity. Following is an example of the teacher allowing students to construct their own understanding:

Chloe: You forgot Pluto.

Teacher: I know I forgot Pluto. I think Pluto is… it’s kind of, I don’t know if I wanna tell you about it, that it’s not a planet or I do wanna tell you, it is a planet. Because it’s still kind of both. We’re still not –right right- a hundred percent sure as to if it is one of our planets like the other planets or if it’s a different type of planet, or different type of object.

Sam: I have seen a TV program and it said it is not a planet anymore.

Teacher: Ok. We’ll get to it.

Chloe: What makes Pluto not a planet?

Teacher: Some people see Pluto as a planet still. For our book, they do consider it a planet. The book is written before they made that discovery. So, it wasn’t really a question then. And for many years, I guess when I was in school. Pluto is a planet. We have nine planets. That’s how we learned. Uhm, but the more and more we learn and kind of grow up with our research and technology, we can build, the more we see in our solar system, the farther we can get and the more we learn. Uhm, but the book says it is our ninth planet it is way way out there.
The research literature supports that providing children supportive and appropriate levels of assistance is crucial for student learning. Simplifying and pointing out discrepancies are necessary for students’ knowledge construction. Teacher support is essential for increasing students’ interest and engagement in their learning. Appropriate levels of guidance and support in classroom instruction results in improved student understanding and comprehension (Palincsar, 1986; Watson, 1996). The findings of the current study revealed that structuring open-ended questions to initiate higher-order thinking or engaging the students in high demanding tasks did not appear to be the priority of the teacher. Rather, the teacher seemed to cover and teach the concepts of the lesson as effective as possible while providing some support for improved student understanding via high quality interactions. Teacher support was often provided by way of in-depth explanations and clarifications for the whole class. Students who fell behind their classmates seem to have benefited more from the individual instruction, and the teacher used individual instruction as a tool to close any gaps in understanding between high and low achieving students.

**Teacher-Child Interactions and Teacher-Child Relationships**

Quality teacher-student interactions and relationships are considered to be important factors for effective classroom instruction and improved student learning. One of the main purposes of the current study was to present any connections between teacher-child relationships and teacher-child interactions that take place in a third grade elementary classroom. The teacher-student interactions included twelve types of interactions that were used to explain the nature (i.e., positive, negative, neutral) and quality (i.e., high, moderate) of teacher-child interactions. The quality of teacher-child relationships were assessed by the Student-Teacher Relationship
Scale (STRS) (Pianta, 2001). STRS provides a total score explaining teachers’ perceptions of their relationships with individual students.

The results of the current study revealed that the teacher’s perception of her relationships with the students differed from one student to another. The teacher was asked to rate her relationship with each student on the closeness, conflict, and dependency subscales of STRS. The closeness subscale, measuring the perceived warmth, openness and emotional support between the teacher and the student had the highest range of 37-51. The teacher indicated a closer relationship with some of the students and evaluated her relationship with other students as more conflicted. Those students who seemed to have more conflicted relationships with their teacher had a moderate range of 51-60 that the classroom teacher perceived as unfriendly, discordant, and uncooperative. Students’ over-reliance and dependency on the teacher support as perceived by the classroom teacher did not seem to change much from one student to another and the dependency subscale indicated a low range of 23-25. This is also consistent with the literature that teacher-student interactions and relationships vary based on the quality of the relationships. Many factors (e.g. the relationship being close or conflicted, secure or unsecure, positive or negative, formal or informal, affectionate or distant) could play a role in the nature and quality of the teacher-student relationships. Depending on such factors, teachers establish interactions with the children that they hope will result in improved student understanding and better academic outcomes (Birch & Ladd, 1998; Elicker & Fortner-Wood, 1995; Pianta et al., 1995).

The findings of the study suggested that there was a significant correlation between teacher-student relationships and teacher-student interactions in the classroom (r=.553, p<.05). It appears that classroom conversations mostly took place between the teacher and the students.
with whom the teacher perceived she had better relationships. Positive (e.g., positive comment, clarifying) and neutral interactions (e.g., directive comments, restating) represented most of the teacher-student interactions during the instruction. Both positive ($r = .491, p < .05$) and neutral interactions ($r = .514, p < .05$) had a significant correlation with the teacher’s perceptions of her relationships with the students. However, the teacher seemed to get involved in negative interactions with the students when she felt necessary, regardless of her overall relationship with a student. There was no significant correlation between the teacher-student relationships and negative teacher-student interactions ($r = .359, p > .05$). It appeared that teacher-student relationship played a significant role in students’ interactions with their teacher and their level of participation during the lessons. This might be related to the comfort level of the students when interacting with their teacher as it also related to their self-esteem. The teacher committing herself to listening to what each student has to say and acknowledging the importance of their ideas played a significant role in teacher-student interactions. It appeared that students with a positive relationship with their teacher took more part in classroom conversations. This is consistent with the research by Hamre and Pianta (2001) who noted that those students who have positive relationships with their teacher show more confidence in exploring the limits of their learning environment both academically and socially. They are more eager to deal with academic challenges and to discover new information.

The closeness of the teacher-student relationship seemed to be the most important factor affecting the overall number of teacher-student interactions in the classroom ($r = .511, p < .05$). The teacher having a close relationship with a student appeared to impact the student’s willingness to take part in classroom discussions. Teacher-student relationships played a vital role in students’ readiness to share their ideas and their confidence of involvement in the teacher-student
interactions without any hesitation. Interestingly, the closeness of the teacher-student relationships did not necessarily warrant positive teacher-student interactions. On the contrary, the students who had closer relationships with their teacher and participated more in the classroom talk got involved in more negative interactions than their counterparts ($r=.493$, $p<.05$). This might be due to the teacher’s effort to provide a fair chance of speaking for all students. Limiting the number of interactions with those students who feel more comfortable in the classroom talk and keeping them under control seemed to be the main concern of the teacher. By creating opportunities for the shy or less socially interactive students, the teacher’s goal was to have an inclusive learning environment for all the students. The findings of the study also provided evidence that positive teacher-student interactions were significantly correlated with the dependency ($r = .521$, $p<.05$), and student’s over-reliance on the support of the teacher was supported by positive teacher-student interactions.

The quality of the teacher-student interactions during the lesson is important as it relates to improved student learning. The findings of the study suggested a strong relationship between the teacher’s perception of her relationships with the students and the quality of teacher-student interactions in the classroom. The current study approached the quality of the interaction types in two dimensions; moderate and high quality interactions. Both moderate ($r=.547$, $p<.05$) and high quality ($r=.496$, $p<.05$) teacher-student interactions were significantly correlated with the teacher-student relationships. The observations of moderate and high quality interactions tended to increase as the teacher’s perception of her relationships with the student improved. Most of the interactions in the classroom were observed to be more moderate quality than high quality. The teacher seemed to have moderate quality interactions (e.g., closed questions, restating) more often with those students whom she had closer relationships ($r=.496$, $p<.05$). Such closer
relationships allowed her to manage the pace of the instruction efficiently. It was clear from the observations that positive teacher-student relationships did not necessarily warrant for high quality teacher-student interactions in the classroom. The teacher only had limited time to teach the lesson which also seemed to have prevented her from getting into high quality interactions with the children. Engaging in high quality interactions (e.g., scaffolding questions, clarifying) require the teacher to spend more time on revealing students’ underlying thoughts and providing appropriate support. The teacher seemed to have a concern for using the class time effectively to cover the topics. Thus, it resulted in fewer opportunities for the students to have high quality interactions with their teacher due to time constraints. On the other hand, the teacher was observed to be engaging in high quality interactions when the students were expected to think critically on the topic. Such attempts for improving students’ reasoning required the teacher use class time wisely while providing in-depth explanations and clarifications for correcting any student misunderstandings.

In sum, the teacher-student relationship is correlated with the teacher-student interactions in the classroom. The correlational results do not allow the researcher to make any causal inferences. The relationship between the teacher-student interaction and teacher-student relationship might be reciprocal. It cannot be inferred if the teacher-student relationship is the determinant of teacher interactions in the classroom or if the teacher-student interactions are the determinant of the quality teacher-student relationship. However, quality teacher-student interaction and healthy teacher-student relationship have long been known to influence the effectiveness of the classroom instruction. Children’s cognitive development and learning is strongly related to the social interaction and relationships with significant others (Cazden, 2001). Teacher-student relationship and the quality of interactions between the teacher and the students
have an impact on children’s social, emotional, and cognitive development (Birch & Ladd, 1998; Hamre & Pianta, 2001).

**Teacher-Child Interactions and Student’s Conceptual Understanding of Science**

The nature and quality of teacher-student interactions that take place in the classroom and their effect on students’ educational success or failure is of considerable importance. The current study investigated any relationships and factors that may influence students’ conceptual understanding of science in a third grade classroom. The purpose of the current study was not to impose a treatment on a particular group of students, or determine the differences between a control and treatment group but looked for any correlations between the teacher-student interactions and students’ conceptual understanding of science as it occurred in the natural setting of a third grade science lesson.

Students' conceptual understanding of science was measured by the pre- and post-tests which were administered to the students at the beginning and at the end of a science unit on solar system. The findings of the study revealed that student’s conceptual understanding related to the specific science unit improved during the science lessons. Regardless of the student’s pre-test scores being low or high, all students showed a steady progress in their learning of the topic and improved their scores on the post-test. The mean score of 22.53 for the pre-test increased to 35.47 for the post-test and the gap between the high and low achieving students’ conceptual understanding scores declined during the science unit. The minimum student score of 14 for the pre-test increased to 29 for the post-test, and students improved their understanding of concepts covered during the science unit.

The findings of the study did not suggest any significant relationship between the nature of teacher-student interactions in the classroom and the student’s conceptual understanding of
science during the science unit. Students’ improvement in conceptual understanding did not relate to their one-to-one interactions with the teacher but they seem to have benefited from the classroom instruction as a whole. The three dimensions of the nature of interactions group (positive, negative, neutral) also did not show any significant correlation with the student’s conceptual understanding of science. Similar results were also observed for the quality of interactions group and its two dimensions; moderate and high quality teacher-student interactions. There were no significant relationship between the quality of teacher-student interactions and the student’s conceptual understanding of science.

In sum, the findings of the study suggested that student’s conceptual understanding improved during the science unit, however it was not necessarily correlated to the nature and quality of the one-to-one interactions that students have experienced with their teacher. Classroom interaction and the teacher’s instructional practices as a whole seemed to have a greater impact on student learning and was evident in improved post-test scores. Students seem to have benefited from their teacher’s interactions with the other students in the classroom and their improvement of conceptual understanding during the science unit was not significantly correlated to their individual interactions with the teacher, or the nature and quality of those interactions. A positive classroom environment rich in peer and teacher-student interactions appeared to create a supportive atmosphere conducive to learning for all the students. Regardless of the students’ pre-test scores, both high and low achieving students seem to have benefited from participating in classroom activities and discussions. The teacher’s interactions with the students as a whole class appeared to have created a positive atmosphere that had much greater impacts on student learning than the teacher’s individual interactions with a particular student. The students’ seemed to have used their teacher’s interactions with any of their classmates as an
opportunity to expand their knowledge and regarded those social interactions inclusive to their own learning. Prior research rightfully stressed the importance of creating a positive classroom environment and a friendly classroom atmosphere that is necessary for generating student’s interest in science. Teachers are long believed to be responsible for creating a more desirable classroom environment suitable for active learning and social interaction where students can construct their own understanding via authentic tasks, not only in science, but in all disciplines (Colburn, 2000; von Glasersfeld, 1984, 1993, 1995b). Both Piaget and Vygotsky believed in the important role of peer interaction in learning and development. Vygotsky emphasized the importance of interactions between more and less knowledgeable individuals and viewed social interaction at the core of the developmental process. Children’s interactions with their peers and adults in a social context play an important role in learning and development (Mercer & Littleton, 2007). The findings of the current study suggested that students improved their conceptual understanding of science in a social context, and both peer and classroom interactions that occurred in the classroom were part of that social atmosphere fruitful for student learning.

**Teacher-Child Relationships and Student’s Conceptual Understanding of Science**

The current study looked for any connections between the teacher-student relationships and the students’ conceptual understanding of science during the science unit. The quality of teacher-child relationships were assessed by the Student-Teacher Relationship Scale (STRS) (Pianta, 2001). STRS gave a total score of teacher's perception of her relationship with each individual student and also provided a sub score for its three subscales, closeness, conflict, and dependency. STRS scores of the students ranged from 111 to 136 with a mean score of 130.88 indicating a variance in teacher-student relationships in the classroom. The closeness subscale looking for the warmth, openness and emotional support in the relationship seemed to have the
most variance, and student scores ranged from 37 to 51 indicating a closer or more distant relationship with some of the students in the classroom. Although moderate in range 51 to 60, similar results were also observed for the conflict subscale indicating the existence of unfriendly, discordant, and uncooperative relationship between the teacher and some of the students, to a certain extent. The dependency subscale however did not indicate much difference from one student to another, and the teacher perceived her students’ over reliance on her support almost same for all the students ranging from 23 to 25..

The correlation between teacher-child relationships and students’ conceptual understanding of science was investigated. Analysis of the pre- and post-test scores of the students revealed that student’s conceptual understanding related to the specific science unit improved during the science lessons. However, the findings of the study did not suggest any significant relationship between the teacher-student relationships and the student’s conceptual understanding of science during the science unit. Students’ improving their understanding and increasing their post-test scores did not have any significant correlation with the teacher’s perception of her relationship with the students, the total STRS scores ($r = .297$, $p > .05$). Similar results were also observed for all three subscales of STRS, and there was no significant correlation between the students’ conceptual understanding of science and the STRS subscales of closeness ($r = .246$, $p > .05$), conflict ($r = .322$, $p > .05$) or dependency ($r = .094$, $p > .05$).

The findings of the study revealed that students improved their conceptual understanding during the science unit however it was not significantly correlated to the teacher-student relationships as perceived by the teacher. This may be due to the effort of the teacher aiming to create a learning atmosphere that is fertile and productive for all the students, and not just for those that the teacher considered to have better relationships with her. Wubbels and Levy (1993),
rightfully emphasize the importance of teachers’ behaviors in the learning environment as it strongly relates to the student’s interests towards learning. The findings of the current study suggested that regardless of their teacher’s perception of the relationship as close, dependent or conflictual, the students did not seem to notice or experience any negative behaviors from their teacher that would hinder their learning and interest in science. The teacher seemed to be successful in creating a supportive learning environment where all students experience the joy of learning as they participate in classroom activities and discussions. The teacher was able establish an open learning atmosphere that moved each of her students’ conceptual understanding of science to a higher degree and provided support for generating student’s interest in science.

**Educational Implications and Contribution to Elementary Education**

The findings of the study provide empirical evidence that the teacher utilizes classroom talk in several ways to create a learning environment that is necessary for generating student interest in science. Classroom teachers providing opportunities for students to express their ideas and supporting them in their efforts to make sense of the scientific facts allow students to actively construct their knowledge through classroom interactions. Twelve types of teacher-student interaction categories that were used to investigate the classroom talk during the science lessons successfully captured all the verbal interactions that the teacher used to; diagnose student understanding, explore and extend student ideas, clarify comments, provide feedback, express approval or dissatisfaction, request certain behavior, establish rules, express frustration, provide additional help and etc. The nature of the teacher-student interactions during the science lesson appeared to be more neutral and positive than negative, and the quality of the teacher-student interactions were more moderate than high in quality.
The classroom teacher devoted limited time for high quality teacher-student interactions such as; open-ended questions, clarifying comments, scaffolding and individual interaction. The teacher seemed to create a balance between the time she could devote to the high demanding classroom activities and meeting the objectives of the lesson and the goals of the curriculum. Structuring open-ended questions to initiate higher-order thinking and engaging the students in high demanding tasks and providing them individual help as needed may not always be possible for the teacher. It is no surprise that such teacher-student interactions require more instructional time which teachers often do not have. As discussed in the literature, the teacher has endless responsibilities in the classroom as it relates to the learning environment. Teachers are not only responsible for teaching the curriculum, but also have other responsibilities such as; establishing classroom norms, enforcing behavioral guidelines, planning for student participation and classroom activities and taking care of routine classroom duties and administrative chores (Doyle, 1986; Howes & Hamilton, 1993; Pianta, 1997). Alexander (1992) referred to the dilemma teachers experience on a daily basis when planning for classroom activities that require teacher guidance and help. Teachers devote more time to individual interaction during more demanding classroom activities for those who need it, but less support is available for other students. Less demanding classroom activities require less time and support for individual student learning but at the same time, those activities are less likely to generate student interest and dedication as well.

Teacher student-relationships and students’ individual personalities have been known to have an effect on students’ enjoyment of science lessons (Creemers, 1994). Teacher-student interactions during the science lessons may take place in quite different ways that also create opportunities for students to improve their conceptual understanding of science (Brown & Hirst,
The nature and quality of teacher-student interactions during the science lessons appeared to be related to the teacher’s perception of her relationship with the students. The teacher had more positive and neutral interactions with children who also had higher teacher-student relationship scores. Negative teacher-student interactions were not related to the teacher’s relationship with the students, and the teacher appeared to get involved in such interactions only when it caused a problem for the steady progress of the lesson.

Teacher-student relationships and the nature and quality of teacher-student interactions in the classroom did not have any significant relationship with the students’ conceptual understanding of science during the science unit. Students’ improvement in conceptual understanding of science appeared to be related to the positive classroom environment and the friendly classroom atmosphere created by the teacher and did not relate to the student’s individual interaction or relationship with his/her teacher. Prior socio-psychological classroom environment research has shown that relationships exist between students’ academic achievement, motivation, academic engagement, and the classroom environment (Fraser, 1998, 2002; Fraser & Walberg, 1991). Students’ perceptions of the learning environment and their attitudes toward the subject being taught and their satisfaction with school are thought to be associated with educational effectiveness and student outcomes (Fraser, 1998, 2002; McRobbie & Fraser, 1993; Moos, 1979; Wubbels & Levy, 1993).

The current study contributes to the prior research and once again supports the importance of a friendly classroom environment for student learning. A learning environment that is rich in social interactions and student participation allows students to construct their own conceptual understanding of science. All students in the classroom enjoy benefits from actively participating in the learning process while reflecting on each other’s ideas and experiences.
Limitations and Suggestions for Future Research

There were several limitations with the current research.

This study was primarily limited because of its small sample size. The current study was conducted only with third grade students in one classroom. Including more classrooms from different schools could have increased the generalizability of the findings of the study to other populations. Future research should aim for a larger sample size by including more classrooms and teachers in the study. A larger sample would have benefited the study results and their generalizability.

Another limitation of the study was the limited number of classroom observations. The study only included eleven hours observations of one third grade science unit. Investigating the teacher-student relationships and teacher-student interactions during the instruction of multiple science units would have captured any improvement in student understanding. A replication of this study should include observations from a longer period of instructions and look for any improvements in student outcomes throughout the year.

The current study investigated the correlations between teacher’s perception of the teacher-student relationship and the teacher-student interactions in the classroom. However, “student’s perception of the relationship” might be another factor to consider when observing teacher-student interactions during the science lessons due to its possible effects on the nature and quality of the interactions. Future research might include the student side of the relationship variables in order to have a better understanding of teacher-student interactions in science classrooms.

Finally, the current study was an attempt to understand the relationships between teacher-student relationships, teacher-student interactions and students’ conceptual understanding of
science. The correlational results from this observational study do not allow the researcher to make any causal inferences. A future study can be conducted to investigate if any of the factors used in this research has an effect on the students’ conceptual understanding of science. For this purpose, new research should include other important variables, student or teacher factors, that may have an effect on the student science outcomes. Such variables (e.g., teachers’ content knowledge, teaching experience, teachers’ attitude towards science, parents’ educational level, families’ socio-economic status) should be drawn from the literature concerning student science outcomes.
APPENDIX A

LETTER OF CONSENT FOR THE TEACHER

Letter of Consent for the Teacher

Dear ____________________

I am a graduate student in the Elementary Education program at the Florida State University. I am conducting a research study on teacher-child relationships and teacher-child interactions in elementary science lessons under the supervision of my major Professor Dr. Htosh Jones from Florida State University, School of Teacher Education Department. The purpose of the study is to investigate and explore the features of social interaction and teacher-student relationships at elementary grade level. The study focuses on the teacher-child interactions and teacher-child relationships in science lessons and investigates how student learning in science occurs as a result of teacher student interactions and classroom talk, and what type of teacher-child interactions inhibit or stimulate student learning in science.

I would be grateful if you could participate in my study. Your participation will involve completing a short teacher-student relationship scale (STRS) (Plants, 2001), for each child in your classroom, twice, at the beginning and the end of the study. In addition, I will work with you to develop a unit test to assess students' learning of science concepts covered during my observations. If you agree to participate in the study, you will be observed in the classroom during your regular teaching activities for a maximum of ten occasions over a period of approximately eight weeks. During these observations, I will observe and record on paper, video, and audio tape your interactions with your students. Your participation in this study is voluntary. You may choose to withdraw from the study at any time. The results of the research study may be published, but your name will not be used.

There are no foreseeable risks or discomforts if you agree to participate in this study.

Although there may be no direct benefit to you, the possible benefit of your participation is that elementary education professionals will be provided with valuable insight into the relationship between teacher-child relationship and teacher-child interactions in science lessons. This knowledge will assist educators and practitioners in developing more effective strategies to enhance the relationship and interactions between teachers and children.

If you have any questions concerning this research study or your participation in the study, please contact me at ____________________

Sincerely,

Bulent Kocyigit

Researcher Signature Date

I give my consent to participate in the above study. All information obtained during the course of this study will remain confidential to the extent allowed by law. All documents and/or data will be stored in a locked filing cabinet in the researcher's home office and will be destroyed upon completion of the study. All data will be destroyed after 12 months from the collection date.

(signature) (date)

FSU Human Subjects Committee approved on 10/13/2011 Void after 4/11/2012 HSC # 2011 6339
APPENDIX B

CHILD ASSENT FORM

Child Assent Form

Dear ________________

My name is Bülent Kocygıt. I am a student researcher from Florida State University. I am conducting a study on how your teacher interacts with you and your classmates in science classes. My goal is to find out the details of the interactions you have with your teacher in science and how your learning is affected by those interactions.

If you agree to participate in the study, I will observe you along with your classmates in your classroom during your regular classroom activities 10 times or less over a period of two months. When I come for observations, I may take notes on my notepad, videotape or audiotape your teacher’s interactions with you. I will also give you a science test at the end to study on the topics your teacher taught you.

Please talk this over with your parents before you decide whether or not to participate. We have asked your parents to give their permission for you to take part in this study. But even if your parents said “yes” to this study, you can still decide not to take part in the study, and that will be fine.

If you do not want to be in this study, then you do not have to participate. This study is voluntary, which means that you decide whether or not to take part in the study. My observations will not affect what you normally do in the classroom. Being in this study is up to you, and no one will be upset in any way if you do not want to participate or even if you change your mind later and want to stop.

You can ask any questions that you have about this study. If you have a question later that you did not think of now, you can call me at [blank] or ask me next time.

Sincerely,

Bülent Kocygıt

Researcher Signature     Date

Signing your name at the bottom means that you agree to be in this study. All information obtained during the course of this study will remain confidential to the extent allowed by law. All documents and/or data will be stored in a locked filing cabinet in the researcher’s office and will be destroyed upon completion of the study. All data will be destroyed after 12 months from the collection date.

________________________ (Student’s signature) ____________________ (date)

FSU Human Subjects Committee approved on 10/13/2011  Void after 4/11/2012
HSC # 2011.5089
APPENDIX C

LETTER OF CONSENT FOR THE STUDENT

Letter of Consent for the Student

Dear ____________________,

I am a graduate student in the Elementary Education program at the Florida State University. I am conducting a research study on teacher-child relationships and teacher-child interactions in elementary science lessons under the supervision of my major Professor Dr. Itchel Jones from Florida State University, School of Teacher Education Department. The purpose of the study is to investigate and explore the features of social interaction and teacher-student relationships at elementary grade level. The study focuses on the teacher-child interactions and teacher-child relationships in science lessons and investigates how student learning in science occurs as a result of teacher student interactions and classroom talk, and what type of teacher-child interactions inhibit or stimulate student learning in science.

I would be grateful if you could participate in my study. If you agree to participate in the study, you will be observed in the classroom during your regular classroom activities for a maximum of ten occasions over a period of approximately eight weeks. During these observations, the researcher will observe and record on paper, video and audio tape your interactions with your teacher. You will be administered a unit test at the end of a science unit covered during the study.

There are no foreseeable risks or discomforts if you agree to participate in this study. Participation or non-participation in this study will not affect your grades or replacement in any programs. Your participation in this study is voluntary and you have the right to withdraw from the study at any time without consequences. No compensation is offered for participation.

Although there may be no direct benefit to you, the possible benefit of your participation is that elementary education professionals will be provided with valuable insight into the relationship between teacher-child relationships and teacher-child interactions in science lessons. This knowledge will assist educators and practitioners in developing more effective strategies to enhance the relationship and interactions between teachers and children.

If you have any questions concerning this research study or your child’s participation in the study, please contact me at ____________________.

Sincerely,

Buena Kocyigit

Researcher Signature __________ Date __________

I give my consent to participate in the above study. All information obtained during the course of this study will remain confidential to the extent allowed by law. All documents and/or data will be stored in a locked filing cabinet in the researcher’s home office and will be destroyed upon completion of the study. All data will be destroyed after 12 months from the collection date.

__________________________ (signature) ____________________ (date)

APPENDIX D

LETTER OF CONSENT FOR THE PARENT/GUARDIAN

Dear Parent/Guardian:

I am a graduate student in the Elementary Education program at the Florida State University. I am conducting a research study on teacher-child relationships and teacher-child interactions in elementary science lessons under the supervision of my major Professor Dr. Ithel Jones from Florida State University, School of Teacher Education Department. The purpose of the study is to investigate and explore the features of social interaction and teacher-student relationships at elementary grade level. The study focuses on the teacher-child interactions and teacher-child relationships in science lessons and investigates how student learning in science occurs as a result of teacher-student interactions and classroom talk, and what type of teacher-child interactions inhibit or stimulate student learning in science.

I would be grateful if you would allow your child to participate in my study. If you give your permission for your child to participate in the study he/she will be observed in the classrooms during their regular classroom activities. A maximum of ten observations will be conducted over a period of approximately eight weeks. During these observations the researcher will observe and record on paper, video and audio tape your child’s interactions with his or her teacher. Your child’s teacher will also be asked to complete a survey assessing the quality of the his/her relationship with your child.

All information obtained during the course of this study will remain confidential to the extent allowed by law. The participants’ name or school’s name will not be associated in any way with the data gathered or the findings of the research. The results or findings will be used for the purpose of this study only. If the results are published, the participants’ name or school’s name will not be used. Once the study is completed, all documents and/or data will be destroyed.

Participation or non-participation in this study will not affect the children’s grades or replacement in any programs. Your child’s participation in this study is voluntary and you or your child have the right to withdraw from the study at any time without consequences. No compensation is offered for participation.

Although there may be no direct benefit to your child, the possible benefit of your child’s participation is that elementary education professionals will be provided with valuable insight into the relationship between teacher-child relationship and teacher-child interactions in science lessons. This knowledge will assist educators and practitioners in developing more effective strategies to enhance the relationship and interactions between teachers and children.

If you have any questions concerning this research study or your child’s participation in the study, please contact me at

Sincerely,

Dahen Kocyigit

Researcher Signature Date

I give consent for my child to participate in the above study.

I understand that my child’s participation in the study is totally voluntary. All information obtained during the course of this study will remain confidential to the extent allowed by law. All documents and/or data will be stored in a locked filing cabinet in the researcher’s home office and will be destroyed upon completion of the study. All data will be destroyed after 12 months from the collection date.

I understand there is no possibility of risk involved if I agree to allow my child to participate in this study. My child’s name will not appear on any of the results or reports.

Parent’s Name: ___________________________ (Date) ____________

APPENDIX E

FSU HUMAN SUBJECTS COMMITTEE APPROVAL LETTER

Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32310
(850) 644-8673, FAX (850) 644-8162

APPROVAL MEMORANDUM

Date: 10/18/2011

To: [Redacted]
Address: [Redacted]
Dept. EDUCATION

From: Thomas L. Jacobsen, Chair

Re: Use of Human Subjects in Research
AN EXPLORATION OF TEACHER-CHILD RELATIONSHIPS AND INTERACTIONS IN ELEMENTARY SCIENCE LESSONS

The application that you submitted to this office in regard to the use of human subjects in the research proposal referenced above has been reviewed by the Human Subjects Committee at its meeting on 04/11/2011. Your project was approved by the Committee.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approval, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 4/11/2012 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to ensure that the project is being conducted in compliance with our institution and with IRB regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is FWA00000146/IRB number IRB00006446.

Cc: [Redacted], Advisor
HSC No. 2011.6089
FLORIDA STATE UNIVERSITY SCHOOLS, INC.
3000 School House Road
Tallahassee, FL 32311
(850) 245-3700   FAX (850) 245-3737
www.fsus.fsu.edu

FLORIDA STATE UNIVERSITY SCHOOLS,
LETTER OF SCHOOL APPROVAL

October 1, 2011

Dear Florida State University Institutional Review Board Committee

Florida State University Schools welcomes the opportunity to support research and collaboration toward further investigation of the nature and the quality of the teacher-student interactions and relationships that may have an effect on students' willingness to engage in scientific activities and student learning in science. This information is pertinent to educational professionals and an area of much needed research. I give permission for Bulent Kocyigit (primary investigator) to recruit teacher, student, and parental consent for conducting research at the elementary school level at Florida State University Schools.

Sincerely,

Dr. Lynn Wicker
# APPENDIX G

## STUDENT-TEACHER RELATIONSHIP SCALE

<table>
<thead>
<tr>
<th>Child</th>
<th>Sex</th>
<th>Age</th>
<th>Ethnicity</th>
<th>Grade</th>
<th>Teacher</th>
</tr>
</thead>
</table>

Please reflect on the degree to which each of the following statements currently applies to your relationship with this child. Using the scale below, circle the appropriate number for each item.

<table>
<thead>
<tr>
<th>Definitely does not apply</th>
<th>Not really</th>
<th>Neutral, not sure</th>
<th>Applies somewhat</th>
<th>Definitely applies</th>
</tr>
</thead>
</table>

1 | 2 | 3 | 4 | 5 |

- I share an affectionate, warm relationship with this child.
- This child and I always seem to be struggling with each other.
- If upset, this child will seek comfort from me.
- This child is uncomfortable with physical affection or touch from me.
- The child values his/her relationship with me.
- This child appears hurt or embarrassed when I correct him/her.
- When I praise this child, he/she beams with pride.
- This child reacts strongly to separation from me.
- This child spontaneously shares information about himself/herself.
- This child is overly dependent on me.
- This child easily becomes angry with me.
- This child tries to please me.
- This child feels that I treat him/her unfairly.
- This child asks for my help when he/she really does not need help.
- It is easy to be in tune with what this child is feeling.
- This child sees me as a source of punishment and criticism.
- This child express hurt or jealousy when I spend time with other children.
- This child remains angry or resistant after being disciplined.
- When this child is misbehaving, he/she responds well to my look or tone of voice.
- Dealing with this child drains my energy.
- I’ve noticed this child copying my behavior or ways of doing things.
- When this child is in a bad mood, I know we’re in for a long and difficult day.
- This child’s feelings toward me can be unpredictable or can change suddenly.
- Despite my best efforts, I’m uncomfortable with how this child and I get along.
- This child whines or cries when he/she wants something from me.
- This child is sneaky or manipulative with me.
- This child openly shares his/her feelings and experiences with me.
- My interactions with this child make me feel effective and confident.
APPENDIX H

SCIENCE UNIT TEST

UNIT TEST

Read each sentence. Choose the answer that gives the best meaning for the boldface word.

1. Earth makes a complete rotation every twenty-four hours.
   a. circle   b. spin   c. day   d. week

2. The Sun is a star that gives Earth heat and light.
   a. super-sized planet   c. very distant object
   b. huge rock   d. hot ball of gases

3. In a year, Earth makes one revolution around the Sun.
   a. circle around a center   c. trip to and from
   b. set of seasons   d. change of direction

4. In a lunar eclipse, Earth moves between the Sun and Moon.
   a. blocking of the Sun’s light   c. Earth’s shadow covering Moon
   b. blocking of the Moon by Earth   d. Moon’s shadow covering Earth

5. Long ago, people named each constellation of stars.
   a. any cluster of stars   c. quarter of the sky
   b. group of stars in a pattern   d. half of the sky

Choose the letter that best completes the statement or answers the question.

6. A Full Moon can be seen about once every __________
   a. night   b. month   c. season   d. year.

7. You can see many more stars if you use a __________
   a. calendar.   c. microscope.
   b. telescope.   d. hand lens.

8. What season does the southern half of Earth have if Earth’s north axis is tilted toward the Sun?
   a. spring   b. fall
   c. summer   d. winter

9. Which of the following is closest to the Earth?
   a. Moon   b. Sun
   c. stars   d. constellations
10. Earth spins around an imaginary line called the __________
   a. axis.       b. eclipse.     c. horizon.    d. rotation.

11. What causes night and day on Earth?
   a. The rotation of Earth.       c. Earth revolving around the sun.
   b. The moon moving around Earth. d. Wind moving across Earth.

12. How long does it take for Earth to rotate one time?
   a. About 24 days         c. About one year
   b. About 24 hours        d. About one week

13. How long does it take Earth to revolve around the sun?
   a. 7 days                  b. 27 days    c. 30 days    d. 365 days

14. Shadows cast by the Sun are the shortest __________
   a. at noon.               b. in the morning.
   c. in the evening.        d. in the afternoon.

15. The northern half of Earth tilts away from the Sun during which month below?

16. What causes the seasons on Earth?
   a. Earth’s tilt and movement around the Sun
   b. Earth’s rotation on its axis
   c. Earth’s movement around the Moon
   d. Moon’s movement around the Earth

17. During which season the number of hours of daylight is greater than the number of hours of darkness?
   a. Spring              b. Summer    c. Fall       d. Winter

18. How long does it take the Moon to go once around Earth?
   a. longer than the four seasons put together
   b. longer than it takes earth to go around the sun
   c. about as long as it takes earth to rotate once on its axis
   d. about as long as it takes the moon to rotate once on its axis

19. Why do some stars appear dimmer than others?
   a. They are bigger than other stars.
   b. They are hotter than other stars.
   c. They are closer to Earth than other stars.
   d. They are farther away from Earth than other stars.
20. Look at the illustration below.

What is this phase of the Moon called?

a. a full moon
b. a crescent moon
c. a new moon
d. a first quarter moon

21. Which of the statements below best describes the Sun?

a. The Sun is a star.
b. The Sun is a planet.
c. The Sun is a comet.
d. The Sun is an asteroid.

22. Where is the sun located?

a. the center of the universe
b. the center of the solar system
c. the center of the galaxy
d. the center of the Earth

23. How many stars are in our solar system?

a. one
b. millions
c. thousands
d. billions

24. Which of these planets is the farthest from the Sun?

a. Venus
b. Saturn
c. Mercury
d. Neptune

25. Why is Mercury very dry and hot?

a. Mercury is the smallest planet.
b. Mercury is the closest planet to the Sun.
c. Mercury has a reddish surface that holds in the heat.
d. Mercury has a thick atmosphere that holds in the heat.

26. A scientist describes a planet in this way: This planet is an inner planet with two moons. The planet has reddish orange rocky surface. It is the fourth planet from the Sun. Which planet is the scientist describing?

a. Mars
b. Venus
c. Earth
d. Mercury
27. Look at the illustration below.

What is the path shown in the picture?
   a. the rotation of a planet around the Sun
   b. the revolution of the Sun around a planet
   c. the orbit of a planet as it rotates on its axis
   d. the orbit of a planet as it revolves around the Sun

28. What is the huge hurricane-like storm on Jupiter called?
   a. Great Breeze  c. Time Tunnel
   b. Great Red Spot  d. Man on the Moon

29. Which planet is an inner planet with no moons?

30. Which is the largest planet?

31. What planet is the closest to the sun?

32. Which is the hottest planet?
   a. Venus  b. Mars  c. Earth  d. Mercury

33. What do all of the gas giants have?
   a. Oxygen  b. rocky surfaces  c. liquid water  d. rings

34. Which is the only planet that supports many living things?

35. Which planet is the farthest from the sun?
36. Look at the illustration below.

What do the circled planets have in common?
   a. They all have surfaces that support life.
   b. They all have surfaces that are not solid.
   c. They all have surfaces that are made of rock.
   d. They all have surfaces that have liquid water.

37. Which of the outer planets has a surface more similar to the inner planets than to the other outer planets?

38. What are three features that make the variety of living things on Earth possible?
   a. thick clouds, a lot of heat, and liquid water
   b. liquid water, mild temperatures, and thick clouds
   c. the atmosphere, a lot of heat, and a rocky surface
   d. the atmosphere, mild temperatures, and liquid water

39. Which two planets do not have moons?
   a. Pluto and Earth
   b. Neptune and Uranus
   c. Jupiter and Mars
   d. Mercury and Venus

40. Which two planets are closest to Earth?
   a. Pluto and Mercury
   b. Neptune and Uranus
   c. Jupiter and Saturn
   d. Venus and Mars
REFERENCES


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BIOGRAPHICAL SKETCH

Education


2001-2003 Master’s College of Education, Program of Elementary Education, Florida State University, Tallahassee, Florida.

2008 The Graduate Certificate in Educational Measurements and Statistics, Florida State University, Tallahassee, Florida.

Work Experience


2005-2007 Teaching Assistant, Elementary Education Program, Florida State University, Tallahassee, Florida.

2007-2011 Graduate Assistant, College of Education, Florida State University, Tallahassee, Florida.

2011-2012 Program Specialist, Leon County Schools Student Assessments Department, Tallahassee, FL.

Awards
