Challenging A Traditional Social Norm In A Second Grade Mathematics Classroom

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CHALLENGING A TRADITIONAL SOCIAL NORM IN A SECOND GRADE MATHEMATICS CLASSROOM

by

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Education in the Department of Teaching and Learning Principles in the College of Education at the University of Central Florida Orlando, Florida

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ABSTRACT

In an attempt to examine classroom dialogue within a second grade classroom, I encouraged students to participate in mathematics discussions without needing to raise their hands before speaking. I challenged this traditional social norm and established sociomathematical norms as the study progressed. My study showed the effects of this change on the dialogue of students in my classroom. Focus was placed on the participation in classroom discussions when traditional social and sociomathematical norms were in place as well as when new norms were established. The study helped determine the effects of student-centered dialogue on conceptual understanding as demonstrated in the students’ discussions, participation, and written expression.
I dedicate this thesis to my amazing children, Anthony and Sarah. Your support and patience through this process has meant the world to me. You are two of the most giving, loving, and brilliant children I know. I’m so proud to be your mom.
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CHAPTER 1: INTRODUCTION

Rationale

When I considered that my main goal in teaching was for my students to become autonomous learners and for them to construct their own knowledge, I realized a necessity to reevaluate my own practice. It came to my attention that the establishment of the rule, “Raise your hand to speak”, was perhaps contradictory to my main goal. An examination of my mathematics class in particular caused me to question the use of this rule. It may have been inhibiting the autonomy of my students. The current NCTM standards establish guidelines for our students to effectively “Communicate their mathematical thinking…, analyze and evaluate the mathematical thinking and strategies of others…, (and to) use the language of mathematics to express ideas precisely” (NCTM, 2004, p. 60). Perhaps this rule was contradictory to developing these skills. This rule also defined my role as the controller of the conversations in my room. I thought, “Perhaps some changes in the way things have always been done are warranted.” For example, if I was to fulfill a role in the classroom as a facilitator, shouldn’t the students have a more active role? Perhaps the dialogue in the classroom did not need to be controlled by me. I was interested in reevaluating the norms in my second grade classroom including the sociomathematical norms.
Social Norms

Yackel (2001) has identified, through data analysis of teaching experiments, several social norms found in a classroom environment. “These include that students are expected to develop personally-meaningful solutions to problems, to explain and justify their thinking and solutions, to listen to and attempt to make sense of each other’s interpretations of and solutions to problems, and to ask questions and raise challenges in situations of misunderstanding or disagreement” For the purpose of my study, I define social norms in a slightly different way. I will focus on social norms as they relate to expectations of student behavior. I consider the social interactions negotiated by the class to be our social norms. For instance, when students speak to one another, they are expected to address each other by name. They are to speak one at a time and listen while others are speaking. They are also expected to actively participate in discussions rather than passively wait for information to be provided. Furthermore, the social norm of raising a hand before speaking is addressed as something that is a negotiable and not a necessity.

Sociomathematical norms

Yackel (2001), in an attempt to distinguish norms specifically related to mathematics from social norms, uses the term sociomathematical norms. She provides the following definition. “Normative understandings of what counts as mathematically different, mathematically sophisticate, mathematically efficient, and mathematically elegant are examples of sociomathematical norms” (Yackel, 2001, p. 11). Researchers
have found that by examining dialogue and encouraging specific types of verbal exchanges between students, conceptual understanding is enhanced (Cobb, P., Yackel, E., & Wood, T. 1992; Kazemi, E., 1998; Lo, J., Wheatley, G., & Smith, A., 1994, Yackel, E., 1996; Yackel, E., 2001). For the purpose of my study, I define sociomathematical norms as social norms with a lens aimed specifically at the interactions during exchanges between students about their mathematical understanding. Because I was interested in challenging the traditional social norm of raising hands to speak, I conducted action research to examine and explain the sociomathematical norms that would occur as a result. For example, I would anticipate students openly discussing their mathematics. I would consider interactions with other students in which they were defining and renegotiating mathematical understanding, explaining and justifying their work, and challenging the work of others to be sociomathematical norms. I wondered if changing the social norms in my mathematics classroom would have a positive effect on their conceptual understanding. This motivated me to delve into the issue with my students.

**Question**

My question was twofold. I wanted to know, “Would I notice a difference in the quantity and quality of dialogue in my mathematics class if students did not need to first raise their hand before speaking?” and “Would students demonstrate conceptual understanding during these discussions?” Because of my emphasis on quality and conceptual understanding, at the heart of my question was the complicated issue of constructivism.
It seemed there were three aspects to explore to begin finding the answers to my question. I felt the need to 1) examine current teaching practices, 2) reflect on the “Why” of these practices, and 3) to consider my own philosophies as I explored alternatives that could lead to positive change.

**Current Teaching Practices**

Upon entering just about any elementary school classroom you will almost immediately notice the prominent sign on the wall. The way the classroom rules are posted will vary from room to room. It is extremely likely though, that you will encounter the rule, “Raise your hand to speak”. This is one of the many current teaching practices that have become ingrained in the profession of teaching. I have been teaching for ten years. During this time I have come to understand that many of my instructional practices are mere reflections of what has always been done in the past. I, like many other teachers I know, automatically and without any forethought began implementing this rule. I did this because of what I had learned in undergraduate classes and through observation of other teachers. I had learned that it was necessary to implement this rule to maintain control and a positive learning environment in my classroom.

It took exposure to another method during a graduate level mathematics education class to broaden my thinking on this established rule. It was while taking this class that I felt a strong desire to question and explore the norms in my own classroom. I realized that I was learning more because of the norms established in this class than I have learned in the past in more traditional settings.
The “Why” Behind Current Teaching Practices

There are some things, like my mother’s manicotti recipe, that are good to pass along from generation to generation. And like many favored family recipes that are passed along through generations, many strategies and procedures implemented by teachers are handed down from other teachers and are a reflection of how they have always been done. Strategies like providing consistency, stating expectations, and using instructional time wisely are widely accepted practices. There is merit in following a tried and true method. Following the lead of others is often how new teachers acquire the skills necessary to meet the challenging demands of educating our children. There is however, a difference between this type of following and blind following. It is important to know the “Why” that guides our decisions even when we are examining widely accepted practices.

I have found within my own teaching practice that there is a time for following and a time to create a different path. I feel the need to create a different path whenever there is a noticeable difference between my methodology and my beliefs. This conflict causes me to question my daily practice and to seek ways to enhance the education of my students while creating a learning environment that is a better reflection of what I believe to be the best for students.

Alternative Perspectives

There is a current controversy in how mathematics should be taught to elementary students. Proponents of a “back to basics” type of instruction state that without intensive
instruction and memorization of facts, students lack the ability to approach more difficult mathematics (Wu, 1999 & Smith, 2005). Intensive instruction might be defined through a positivist conception of learning. This conception is of knowledge as a thing that can be passed on from teacher to student. The goal of a teacher using this model is to pour as much information as possible into students.

The work of Paulo Freire was grounded in a belief that there was a better alternative. His emphasis of study was on the need for students to be more active. He was very concerned about the need for a democratic education system. He used the metaphor of a bank account and money to describe the current state of our education system. He warned against the mindset that many schools are based on; that teachers can simply make a deposit and expect a return. He emphasized that students are not accounts and this type of mentality must be replaced. His alternative view was that knowledge needed to be constructed and produced in dialogue (Crowther & Martin, 2005).

Unfortunately, there seem to be a multitude of parents and teachers that feel our educational system is just fine. They may feel that if it was good enough for them, it is good enough for students now. Furthermore, I have encountered many parents that have voiced their concern about the use of, “New” math. They don’t understand why we would need to teach anything other than the procedures that they were taught and with which they are familiar. They are very skeptical of a curriculum that appears to be changing the “math rules”.

There is another philosophy based on the need for students to construct their own meaning. When a student has true understanding and is able to apply that knowledge in a
multitude of situations they have constructed their own meaning. Their understanding is obvious and not merely parroting. The goal of a teacher using this model is focused more on quality over quantity.

At the heart of this debate are the students. We have a responsibility to every student that relies on our educational system. What is best for them? Is one method or rationalization better than the other?

**The Need For Change**

I have noticed that students who memorize facts without grasping the underlying concepts cannot easily acquire new mathematics skills. If students do not have a personal connection with the information being taught, they may appear to have learned, but will not be able to make use of this information in meaningful ways. My observations have been validated by conversations with peer teachers as well as through professional reading. The writing of Perkins (1993) addresses the complicated issue of teaching for understanding. His article, “Teaching for Understanding” epitomizes a philosophy about student learning which incorporates a constructivist view of learning. He views a major goal of our schools as imparting knowledge and skill. He states that this focus does not ensure understanding. “Yet rote knowledge generally defies active use, and routine skills often serve poorly because students do not understand when to use them. In short, we must teach for understanding in order to realize the long-term payoffs of education” (p.29). I am concerned when my students seem to be lacking the ability to apply their understanding. These skills are obviously necessary for success in future years.
Conclusion

I was interested in exploring the concept of creating a learning environment conducive to a constructivist approach to mathematics. I felt that allowing students to speak directly to each other would engrain a certain level of ownership. I also envisioned their dialogue becoming more meaningful in nature than just responding to my questions. I wanted my teaching methods to reflect my belief that true understanding had to be constructed by my students and was not something that I could pour into them.

A review of the literature revealed a wealth of information. There are alternatives to traditional teacher-centered learning environments. Teachers and students may negotiate traditional roles and redefine student participation in terms of creating a new sociomathematical norm. Sociomathematical norms have been defined as “normative aspects of mathematical discussions that are specific to students’ mathematical activity” (Yackel & Cobb, 1996, p.459). Yackel and Cobb determined through their research that learning opportunities arise when students discuss their solutions and make judgments about processes.

When students discuss their mathematical thinking and make judgments on the work of others, they are given an opportunity to engage in more thought provoking and engaging activities. The role of the teacher moves from a boss-manager position to a lead-manager position. As a result, students and teachers are not adversaries, rather team players working toward a common goal. In this environment, students take on more responsibility and in turn produce more quality work (Glasser, 1992).
If my students were to become autonomous learners and construct their own knowledge, my role would naturally change. There were many aspects to explore. My review of literature defined constructivism and the link between sociomathematical norms and student understanding. Implementing and examining these topics causes a reflection on the role of teachers and students. The review of literature provided guidelines for the methods I used with my second grade students to help answer my question. There were roadblocks along the way as I attempted to delve into some complicated aspects of teaching and learning. I found that change is a necessary and desirable aspect of teaching. I also learned that challenging a norm in my classroom would provide a wealth of information about my students, my beliefs, and the educational culture in which I work.

My question, “Would there be a difference in the quantity and quality of dialogue in my mathematics class if students did not need to first raise their hands before speaking?” and “Would students demonstrate conceptual understanding during these discussions?” would be a challenging, yet rewarding endeavor.
CHAPTER 2: LITERATURE REVIEW

Introduction

The environment in which learning takes place is an important contributor to success or failure. How can the environment in which students learn mathematics meet their various needs and foster the development of intellectual autonomy? The purpose of this literature review is to explore the Constructivist approach and the influence of sociomathematical norms on the classroom environment.

The establishment of new sociomathematical norms is directly related to the Constructivist approach in that students are active in their role and take responsibility for their part in mathematical discussions. Within these topics, the role of teachers and students will be reexamined. As roles are defined and redefined, the influence of constructivism and norms on the classroom environment will be made clear.

Teachers have traditionally filled a role of controller of power in the classroom. This has implications for both the teacher and the students. A review of the literature suggests alternatives to this as well as other traditional aspects in the classroom. Teachers have the ability to empower their students. They may establish different roles for themselves and their students. “The teacher might frame conflicting interpretations or solutions as a topic for discussion, thus encouraging students to explicitly negotiate mathematical meanings by engaging in mathematical argumentation” (Cobb, Yackel, & Wood, 1992, p.11). Learning that occurs in the context of interactions between students and teacher could be defined as developing a community of learners engaged in creation
of mathematical knowledge. These sociomathematical norms have the ability to effect the learning environment in a way that may facilitate students’ constructing their own mathematical meanings.

**Sociomathematical Norms**

By defining, comparing, contrasting, elaborating, and refuting mathematical ideas, students become initiated into the community of mathematics inquirers (Borasi, 1994). Learning opportunities arise as students participate in classroom social interactions. These interactions provide opportunities for students to reflect on their methods, justify solutions, and share their information with others. When students participate in this way, they strengthen and extend their understanding as well as the understandings of others in the class as they listen to the presentations (Peressini & Knuth, 2000).

When students share their strategies, and are challenged by peers, they build a stronger understanding. They not only learn how to solve problems on their own, but they actively attempt to reconstruct their knowledge as they share it. “Analysis shows that one of the benefits of establishing the social norms implicit in the inquiry approach to mathematics instruction is that they foster children’s development of social autonomy” (Yackel & Cobb, 1996, p.14). The inquiry approach is best defined by a close examination of the activities of students and teachers. Teachers are seen as facilitators while students fulfill an active and investigative role. Lessons are developed and maintained by the curiosity and interests of students. As students explore topics they form
a knowledge base that is experientially meaningful. Through sharing, students are able to understand that there is more than one way to solve a problem. They begin to appreciate various methods and thrive in an environment which enables them to construct their own knowledge.

**The Constructivist Approach**

Constructivism is not an easy term to define. The range of theories and postulations on the subject are staggering. For the purpose of this paper I rely on the work of two prominent figures in the field of education. John Dewey and Ernst von Glasersfeld have defined constructivism and its importance in education. Although their theories and focus are not identical, I chose them for the commonalities they share in regard to student involvement in the classroom and in particular the need for student participation and dialogue. Using the framework of these great educational leaders, I will attempt to examine the meaning of constructivism in the classroom. A compilation of their theories will provide a broad overview of the constructivist approach.

The work of John Dewey is centered on a belief that knowledge must be constructed. He believed that there is no such thing as knowledge outside of the learner. He believed that learning is an active endeavor (Kivinen & Ristela, 2003).

Ernst von Glasersfeld describes constructivism as a theory of knowledge. His theory is based on two premises. One, knowledge is an active acquisition process. It is not something that a learner can passively absorb. Two, the process of coming to know
occurs through adaptation and modification while experiencing the world (Von Glasersfeld, 1995).

Essentially, in its most basic form, the constructivist approach suggests that students need to construct their own knowledge. They learn best by doing, not by being recipients of information. Much research has been conducted to determine the cause of student learning. This is an important and complicated issue. There are researchers who feel that direct instruction provides better results and does not impede, as a constructivist would argue, broad transfer in future authentic situations (Klahr & Nigam, 2004).

Constructivism provides a different perspective. Central to constructivism is its conception of learning. “From the constructivist perspective, learning is not a stimulus-response phenomenon. It requires self-regulation and the building of conceptual structures through reflection and abstraction” (Von Glasersfeld, 1995, p.14). If educators were to attempt to create an environment in which this principle applied, the classroom would take on different characteristics than that of a typical mathematics classroom. For example, students would be engaged in mathematics conversations that would demonstrate their ability to transfer understanding within a variety of situations.

An example of this dynamic classroom environment can be found within a study conducted by a group of researchers working on a grant from the National Science Foundation (Lo, Wheatley, & Smith, 1994). This study closely examined a third grade classroom and the specific interactions between students. The social and mathematical development of one specific student is described as he and his classmates negotiated social and sociomathematical norms. Within the context of this setting, the students were
able to take ownership of their ideas. Their learning was marked by meaningful dialogue. During the study, the researchers identified several themes related to the importance of students defending their thoughts and being able to understand the work of others. These students thrived in an environment that allowed them to talk directly to each other. The teacher chose a role that was to facilitate their discussions and to allow them to establish norms in this setting (Lo, et al., 1994). This is a considerable contrast to a traditional mathematics classroom where students are expected to copy and apply procedures to obtain correct answers.

Unfortunately, many teachers still rely on explain-practice instruction. If teachers are to simply explain a concept and then provide time for the practice of the concept, the students are missing some fundamental experiences. They are essentially taught to regurgitate information. The result of this type of practice is procedural knowledge rather than constructed understanding of mathematical principles. “Numerous national and international studies have shown that the widely practiced explain-practice instruction has failed to foster mathematics achievement” (Lo, et al., 1994, p.30).

Furthermore, according to researchers in the field of mathematics instruction, “Approaches in which the teacher becomes increasingly explicit about what it is that students are supposed to learn can lead to the excessive algorithmatization of mathematics and the disappearance of conceptual meaning” (Cobb, et al., 1992, p.5).
Role of the Teacher

Although change is often a difficult endeavor, it is nonetheless worthwhile in regard to providing a learning environment conducive to student achievement. Educators should attempt to encourage communication and listen to students, thus creating a classroom community in which students construct their own meaning. The ultimate goal of the teacher should be for students to develop intellectual autonomy (Lo, et al., 1994). The merit of intellectual autonomy is that students are empowered with knowledge. There is a level of ownership that could not occur without it.

A major role of the teacher is to help students learn how to communicate mathematical ideas. “Teachers should consider classroom strategies that encourage students to think deeply, to struggle with ideas, and to test ideas out loud” (Rop, 2002, p.718). The teacher must learn to act as facilitator so students can begin to rely on their own intellectual reasoning and build conceptual understanding (Kazemi, 1998). Strategies such as creating a supportive environment, promoting student independence, and teaching students to articulate their ideas can be a benefit to all involved (Silbey, 1999).

“Teachers need to develop the skills of listening to students’ words, interpreting the mathematical ideas they express, and identifying the relationship between student thinking and the mathematics on her agenda” (Schifter & Riddle, 2004, p.4). The teacher should remember that problematic situations provide potential learning opportunities. In a traditional school environment, which often reflects a behaviorist perspective, teachers and students may attempt to avoid errors and at times ignore them.
An alternative perspective is offered and examined through the work of Rafaella Borasi. Although her study was conducted with secondary school students, there are implications for all levels of learners. Her teaching experiment was designed to provide evidence of benefits of using errors as springboards for inquiry in mathematics. She found that students constructed their own knowledge and exhibited conceptual understanding when provided with opportunities to use errors in mathematics investigations. Students began to take control of their own learning and in turn their perceptions of mathematics changed to feeling it was a more accessible and creative domain. Another outcome was that students’ attitudes towards mathematics were more positive (Borasi, 1994).

Much can be learned from student errors. “Errors are seen not only as an inevitable and integral part of learning but also as a valuable source of information about the learning process” (Borasi, 1994, p.170). These errors should be seen as opportunities for growth as opposed to a phenomenon to be avoided.

When teachers choose to change their expectations in regard to student errors, they are making a step toward developing a classroom environment that could support rather than extinguish students constructing their own knowledge. “A consequence of pupil talk and teacher listening is that the teacher is able to glean a sense of the origins of pupils’ ideas and to challenge these in some way if it seems appropriate” (Jaworski, 1996, p.3). “A problem arises when a teacher wants students’ constructions to make sense in her terms; when constructions, meaningful to pupils, may not be adequate for the wider contexts which she has in mind” (Jaworski, 1996, p.4). By allowing for and ultimately
promoting more student involvement and opportunities, teachers can create and maintain a more active role for students as they apply their own constructed meaning in learning situations.

It is important for teachers to consider the objectives they have for their students. Perhaps it is a paradigm shift for teachers to embrace student errors and a more active role for students. However, if their objective is for students to learn in a conceptual way, and not just parrot the work of the teacher, then it may be necessary to reevaluate current teaching practice. An area of exploration for a teacher with this objective may be to examine power relations in the classroom.

**Power Relations**

Teachers make many decisions that reflect both the stated curriculum as well as the hidden curriculum in the classroom. The stated curriculum focuses on the particulars of what is being taught. The subject matter, benchmarks, and use of textbooks would be part of the stated curriculum. The hidden curriculum is more difficult to define, but equally important to explore. Teachers should have an awareness and attempt to make conscious choices in regard to the influences on student learning.

“Power is a structure of relationships—a structure in which teachers and students can build or participate. Power is not an object and cannot be owned by anyone. The structure of relationships is called power because it, rather than the individuals who create it, is what shapes people’s actions” (Manke, 1997, p.1).
One of the choices that teachers make is in regard to seating arrangements in the classroom. This presumably simple choice may signify more than meets the eye. Seating arrangements may send a message to students. For example, if students are seated facing a teacher’s desk, the message sent may be that of teacher control. When students are seated in small groups, a message of student interaction may be projected.

Another aspect of the hidden curriculum deals with dialogue expectations. Students are conditioned very early in their school career to speak at appropriate times. They quickly learn that they must wait their turn and raise their hand to speak. When most of their day is spent listening to the teacher talk, they may perceive their dialogue as less important than the teacher’s dialogue.

Finally, teachers maintain a hidden curriculum in regard to contribution expectations. If a teacher consistently seeks verbal contributions from a select group of students, others in the class may learn that they can simply avoid eye contact and in turn avoid the need to contribute to class discussions. If a student has difficulty determining correct answers and the teacher’s focus is on students that provide correct answers, students may perceive that their dialogue is less important than their more advanced peers.

The establishment and maintenance of Power Relations, although a hidden curriculum, have an influence on the learning that takes place in the classroom. Teachers may choose to establish different expectations for themselves and their students.
Role of the Student

If a constructivist view of learning is evident in the classroom, students are seen actively engaged in their learning. They are not viewed as mere recipients of knowledge. Rather, students are expected to explain and justify their solutions to their peers. In addition, students then are given an opportunity to dispute or argue the merit of the justification. This helps build intellectual autonomy as students become adept at validation (McClain & Cobb, 2001).

“If there is some independent, pre-existing body of mathematical knowledge we cannot know it except through our own experience, and we can only know what we ourselves have constructed, and modified according to further experience” (Jaworski, 1996, p.2). Many students rely on the teacher to deliver knowledge and are not accustomed to the active role that is necessary to their understanding. “Despite the fact that it has been widely called for, researchers agree that other than responding to the teacher’s questions in short phrases, students in mathematics classrooms rarely contribute to classroom discussion” (Lo, et al., 1994, p.47).

“We view the process of attaining intersubjectivity as one in which the teacher and students each construct individual interpretations that they take as being shared with the others” (Cobb, et al., 1992, p.17). Students should be encouraged to participate in creating sociomathematical norms as they redefine their role in the classroom. As a result, students may be more likely to have an opportunity to share their methods and their knowledge with their peers. The work of Michelle Stephan exemplifies this concept as she wrote of a study with a group of first graders developing social and
sociomathematical norms for problem solving. These students were taught how to talk to their classmates during mathematical discussions. They learned how to participate in the establishment and maintenance of norms. As students developed conceptually oriented explanations, their learning was enriched. Students were able to glean information and strategies used by others as they articulated their thinking (Stephan & Whitenack, 2003).

Our students are social beings. They are accustomed to learning as an interactive endeavor. From the very beginning, they learn everything from direct contact with other people. They learn to have their most basic needs attended to and learn their place in the world through interactions. By the time a child enters the education system at age five they have had many opportunities to talk, to listen, to be taught, and to explore their world. I picture my own children at the age of four and realize that they were taught very differently than a traditional school setting. I never expected them to sit quietly as I imparted my wisdom on them. They were busy exploring, asking questions, and interacting with their play things as well as with their friends and others in our family. It was in this rich and diverse environment that they acquired many of the skills that would be the foundational building blocks of all they would be expected to learn in during their school years.

Interaction provides opportunities for interpretation. When students become accustomed to sharing their mathematical ideas with each other, a natural consequence is the need to understand and apply the reasoning of others. Our actions are formed in part by the actions of others (Yackel, 2000). The establishment of social norms is not exclusive to mathematics. When students participate in creating social and
sociomathematical norms they gain skills that may help them in other subjects as well. Guidelines such as describing and defending work, making judgments about the work of others, and comparing thought processes all lead to greater understanding and provide students with strategies that help them meet educational goals. Research in science education has provided similar guidelines for building conceptual understanding. Some commonalities include contributing, supporting ideas with reasons, working to understand others’ ideas, and building on the ideas of others (Palinscar, Anderson, & David, 1993). When these types of skills are developed, students are active and interactive as they approach topics throughout the curriculum.

**Conclusion**

A review of the literature suggests that students need to be active participants in their learning. Educators should strive to create an environment that fosters the construction of true mathematical understanding (Kazemi & Stipek, 2001). This constructed mathematical understanding encourages student ownership of knowledge. It becomes part of the foundation for future learning.

A major goal of school mathematics programs is to create autonomous learners, and learning with understanding supports this goal. Students learn more and learn better when they can take control of their learning by defining their goals and monitoring their progress. When challenged with appropriately chosen tasks, students become confident in their ability to tackle difficult problems, eager to figure things out on their own, flexible in exploring mathematical ideas and trying
alternative solution paths, and willing to persevere. (National Council of Teachers of Mathematics, 2000, p.20).

By reevaluating standard roles of the teacher and student, encouraging active learning, and initiating sociomathematical norms, teachers can facilitate the creation of classroom environments that reflect a constructivist view in the development of mathematical understanding.

I was interested in reevaluating my role and the role of my students. I desired more active participation from my students. I was hoping that redeveloping norms in the classroom would have a positive affect on the environment I was trying to create. I used an action research qualitative approach as I addressed these issues with my students. In my concluding three chapters I will explain my methodology, my data analysis, and my conclusions. The methodology I chose to use was in large part due to the situation I was in. I had easy access to a group of willing second grade students. In my next chapter, I will explain the methods used and the rationale for my study. My question, “Would there be a difference in the quantity and quality of dialogue in my mathematics class if students did not need to first raise their hands before speaking?” and “Would students demonstrate conceptual understanding during these discussions?” will be explored in greater detail in the following chapters.
CHAPTER 3: METHODS

My question, “What affects would establishing the classroom norm of students speaking without raising their hands first have on the quantity and quality of dialogue?” and “Would students demonstrate conceptual understanding during these discussions?” needed to be explored in the context of my second grade classroom. In this chapter I describe the setting and the methods used to gather the information necessary to answer my question.

Design of Study

Because my goal as a teacher was to, “Take action and effect positive educational change based on my findings, rather than being satisfied with reporting my conclusions to others” (Mills, 2003, p.3), I conducted an Action Research study with my students. Action research is a qualitative research study conducted in the natural classroom setting. This was an accessible and non-intrusive way for me to find the answers to my question. It was my goal to give an accurate account and a descriptive narrative of what I observed from day to day after re-negotiating the norms in my second grade mathematics classroom.
Setting

School Setting

Our school is located within the 12th largest district in the nation and the 5th largest district in Florida. The school is located in a middle/high socioeconomic area. There is a 70% stability rate. Free and reduced lunch is offered at the school and 27% of the students qualify. Of the 1,000 students at the school, 30% are speakers of other languages, 12% are enrolled in the gifted program, and 13% have learning disabilities.

Classroom Setting

My action research study was conducted with a diverse group of 16 second grade students. These seven year old students were placed heterogeneously in my class by the principal. They all gave consent and participated in my action research study. During the course of the study, two of my students moved. The class consisted of 9 girls and 7 boys. This diverse group consisted of 10 Caucasian students, 2 Hispanic students, 1 Asian, 1 African American, and 2 students of other ethnic backgrounds. Four of the students received Speech and Language services, five of the students were on an Academic Improvement Plan (AIP), and one of the students received gifted services.
**Methods**

**Data Collection**

After receiving Institutional Review Board (IRB) approval (Appendix A) and principal approval (Appendix B), I sent home parental consent forms (Appendix C). Each student returned the consent form with permission to participate in the study. I read the student assent form (Appendix D) to the students and all students exhibited an enthusiastic consent to participate in the study. I conducted a videotaped interview with each of the students. I used the information from my review of literature to guide my selection of questions. Each student interview lasted only a couple of minutes. The interview questions (Appendix E) provided personal thoughts and perceptions of my students. Questions focused on student perceptions of their mathematical ability, participation in mathematics discussions, and on how they are perceived by their peers. This interview marked the beginning of the data collection phase of my study.

**Procedures**

After the interviews were conducted, I held a discussion with the class on the topic of our current classroom norms. We reviewed the rules and structure of the class. Next, I explained that our project would take our class in a different direction. I explained that we would establish a new norm; one in which they would be able to and expected to talk directly to one another during mathematics instruction.

Because the social and sociomathematical norms were in the foreground during the study, the specific mathematical content addressed was in the background. The
mathematical content was determined by a reform-based text book series based on a spiraling curriculum. During the course of the study I sequentially followed the order of topics presented in the textbook (Table 1).
<table>
<thead>
<tr>
<th>Sequence of Instruction</th>
<th>Mathematical Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week One</td>
<td>Addition and Subtraction Facts; inverse relationships, equivalent forms of same number, recognizing patterns, and solving real-world problems</td>
</tr>
<tr>
<td>Week Two</td>
<td>Addition and Subtraction Facts; inverse relationships, equivalent forms of same number, recognizing patterns, and solving real-world problems</td>
</tr>
<tr>
<td>Week Three</td>
<td>Addition and Subtraction Facts; inverse relationships, equivalent forms of same number, recognizing patterns, and solving real-world problems</td>
</tr>
<tr>
<td>Week Four</td>
<td>Place Value, Money, and Time; counting and grouping objects, counting coins, using digital and analog clocks, displaying and identifying data, and describing given pattern and explaining rule</td>
</tr>
<tr>
<td>Week Five</td>
<td>Place Value, Money, and Time; counting and grouping objects, counting coins, using digital and analog clocks, displaying and identifying data, and describing given pattern and explaining rule</td>
</tr>
<tr>
<td>Week Six</td>
<td>Place Value, Money, and Time; counting and grouping objects, counting coins, using digital and analog clocks, displaying and identifying data, and describing given pattern and explaining rule</td>
</tr>
<tr>
<td>Week Seven</td>
<td>Addition and Subtraction; using concrete objects to solve real-world equations with one unknown, using appropriate instruments for measuring linear dimensions, estimating reasonable solutions and choosing appropriate method of computing</td>
</tr>
</tbody>
</table>
Daily lessons consisted of a mental math warm up, review of a math problem from the morning, direct instruction focused on varying mathematical content, and a time for practice. Each section of the lessons provided a different type of instruction and students were engaged in three different types of learning situations. These consisted of whole group discussions, small group interactions, and paired or individual work in the practice workbook.

I placed a video camera in the room a week before I began discussing the study with the students. The video camera was not a typical part of our classroom environment. Although the camera was off, I felt it would give them an opportunity to become accustomed to it before it was going to be used.

For 3 weeks, I recorded classroom discussions during each one hour math class. I observed their dialogue during typical instructional methods. I then introduced a new social norm that allowed for direct discussion between students without needing to first raise their hands.

To introduce the new norm, I focused on our prior discussions and expectations about good listening and related them to the new expectation. Because it was close to the beginning of the school year, we had recently discussed as a class the kind of classroom environment we wanted to create. We spent time describing in detail the behaviors that would emulate that environment. For example, one discussion was focused on their desire to be able to have an orderly classroom. They helped establish that if the classroom was very loud, and all the children behaved any way they wanted, they would not be able to
think. That led into the development of the rule, “Speak one at a time and listen while others are speaking.”

Because in essence, I was asking that we as a class reexamine our initial discussion, I brought up the topic of our classroom environment again after the initial interview. I explained that during the interview I noticed that most of them thought they would get in trouble if we changed the rule about raising our hand. I told them that we could decide to change that rule. I went into great detail about social norm expectations such as 1) listening and looking at the speaker, 2) addressing the speaker by name, and 3) speaking clearly so as to be understood. I also stated sociomathematical norms such as 1) defining your reasoning in a clear way, 2) asking questions when you don’t understand, and 3) explaining and justifying reasoning to students with questions, and 4) defending your thinking to others. Furthermore, I told them that it was not going to be enough to know how to get a right answer. I would be expecting them to be able to explain how they came up with their solutions. I also explained that mistakes are not only acceptable, they are necessary as we learn new things. The following 4 weeks, I recorded classroom discussions during each one hour math class.

I interviewed the students again at the end of the study. This brief formal interview provided information and triangulation. For this interview I used the initial list of interview questions (Appendix E) and made a few adjustments. This new list of questions (Appendix F) provided an opportunity for the students to share about their experiences with a new norm in their mathematics class.
Data Analysis

I used the following methods to acquire data during this study: video recording during mathematics instruction focusing on student dialogue, student pre- and post-interviews, and student work.

Student work was collected from daily journals. Students used these journals to document their work and their thought processes in solving math problems. Specific questions were asked that coincided with the topic of study. These journals will be discussed in greater detail in the following data analysis chapter. These data provided a wealth of information about the strategies used by my students. It also showed their ability to explain and justify their work on paper. This was an important demonstration of their conceptual understanding.

Summary

The qualitative methodology provided a context for me as I set out to describe in detail the affects of changing the norms in my mathematics classroom. The action research we participated in as a class provided data that helped identify these effects.

Interpretation of these data will be discussed in Chapter Four, Data Analysis. A thorough analysis of the data will describe our experiences and the dynamic difference in our classroom as we explored new social and sociomathematical norms in our mathematics class.
CHAPTER 4: DATA ANALYSIS

Introduction

“Action Research, like any other problem-solving process, is an ongoing creative activity that exposes us to surprises along the way. What appeared to matter in the planning stages of an action research investigation may provide us with only a hint, a scratching of the surface, of what is really the focus for our investigations” (Manke, 2003, p. 2). My study was full of surprises and my focus of investigation changed dramatically during the course of my study.

My initial plan when designing my study was to quantitatively examine the dialogue of my students during two different sections of my action research. It was my intention to look for patterns in the amount of time my students were talking during traditional instruction and then to compare that to the discussions after establishing a new sociomathematical norm. I thought I could use tally marks and classify the discussions of my students into distinct categories. With the aid of the video, I thought I would be able to determine and classify student dialogue in the following categories: Describing or Explaining, Justifying, Questioning, and Challenging.

It is interesting that although I knew I was implementing a different norm in the classroom and in fact identified the need to examine Power Relations in my classroom, it had not dawned on me that perhaps my plan would not work. What I realized soon after viewing the first two video tapes was that it would be an impossibility to compare the dialogue of my students during the different phases of my research. This enlightenment...
ensued when I tried to use my tally mark chart. Suddenly it dawned on me that my students were not necessarily talking as much as they wanted to.

It became obvious to me while watching those tapes that I was controlling the conversations in the classroom. How could I quantify the amount of dialogue when I was the one who determined who would speak at any given moment? As much as I tried to allow for many different students to have the ability to discuss their ideas it was impossible for me to allow every child to talk every time they had a desire to do so. So, what I decided to do instead was to examine the amount of times my students raised their hands. I felt this would at least give me an idea of the times they would like to talk during mathematics discussions.

Unfortunately, this would prove to be another source of disappointment. It would be practically impossible and extremely time consuming to attempt to quantify the number of times each student raised their hand. It also dawned on me that although the students were raising their hand it was not necessarily a sign that they had something meaningful to share. This became obvious to me as I observed a child inquire, “May I use the restroom?” after being called on during class.

Fortunately, I was skilled in action research and armed with the knowledge of my literature review. Besides, I was determined to find the answer to my question, “Would there be a difference in the quantity and quality of dialogue in my mathematics class if students did not need to first raise their hands before speaking?” and “Would students demonstrate conceptual understanding during these discussions?”.
In this chapter, I will describe the patterns I noticed as well as the conceptual understanding that was evident in my classroom as students participated in the establishment of a new norm. First, I examined my practice. Next, I implemented the change. Students were encouraged to talk directly to each other. Finally, I reflected and responded to what I had observed. I may not have been able to accomplish what I had initially set out to do in terms of quantitative examination, but the topic of the following qualitative narrative had a profound impact on me and on my students.

**Roadblocks**

I had expected possible challenges along the way due to various issues with the children. I also expected to possibly face challenges with the parents. I didn’t anticipate the challenges from within. A more difficult aspect of my study was to face the challenges caused by my own internal struggle.

My immediate concern with establishing the new norm was the possibility to completely lose control of my classroom. After all, the students had been obviously well trained to relinquish control of their educational environment. I worried that they would want to overrun the classroom and chaos would prevail.

I acknowledged the possibility of parents who might be threatened by the idea of trying something new with their children. Perhaps they would fear that their children would miss out on the educational experiences that some feel are crucial. It was possible that they would prefer the “tried and true” method of teacher-directed instruction. For example, the very same semester that I began my action research, a parent sent a letter to
a different second grade teacher at our school. The parent stated concern about students using the teacher’s method that had them using partial sums addition for double digit numbers. Using this strategy requires a student to understand that the two numbers in the tens place value would be added. Then the two numbers in the ones place value would be added. Finally, the sums of each would be added to form the total sum. The parent stated that although this strategy seemed to work for the teacher, it would not work down the road when the student needed to add three digit numbers. This parent was missing a couple of very important facts. First, it was not the teacher’s method that she invented. Second, the partial sums algorithm can and does work for any number of digits. This parent lacked not only the conceptual understanding of addition, but also the ability to trust in a system that seemed to be challenging the mathematical rules with which the parent had become familiar.

I did not enter into my study with a preconceived notion of what I would see when challenging a traditional norm. I was, however, driven by a desire to implement and put into practice a theory I whole heartedly believed in. There was an obvious conflict between my beliefs and my practice. This made the challenges I encountered even more difficult to bear.

I noticed that my lessons were governed more by the teacher’s manual than by the concepts and the students. I felt that I needed to “Cover” the material or my students would be at a disadvantage. I felt pressure from many different sources. One thing I noticed immediately with the new norm was how very time consuming activities can be when the focus is on true understanding. I realized an internal struggle. I strongly desired
to hear understanding. I actually caught myself calling on students at times because I knew they could supply the correct answer and then we could move on. There was a certain level of safety in thinking that if I covered the material, the students would have learned.

When I took the time needed for students to delve into concepts, the reward was true understanding that could be applied in a variety of situations. The problem remained that when I allowed students the time they seemed to need, the lesson plan in the book could not be “Covered”. It was a difficult choice to make. I would like to say that I always chose to implement what I know about conceptual understanding and constructivism. However, the school system in which I am employed has spent a considerable amount of money for the implementation of the county-adopted and time-consuming mathematics curriculum. The pressure to comply with this program, combined with my insecurities about my ability of meeting all of the standards, often superceded my desire for students to construct their own knowledge through discussions.

**Student Interactions**

**Student expectations**

I learned that as early as second grade, students have an idea of what is expected of them while in the classroom. They seem to have a firm grasp on what is acceptable and desirable. They have a strong desire to please and to be liked. They long to understand expectations. When I observed my students conversing with their friends in an informal setting I noticed some of the following attributes. They were animated, excited, quick to
correct each other, and they appeared to be consumed by whatever topic was at hand.

This was a stark contrast to what I observed during the more traditional phase of my action research project.

**Student Interactions in a “Traditional” Setting**

During the initial phase of my study, which is reflective of a traditional classroom setting, I noticed some interesting attributes. When looking at it in a positive light I would notice that there is a level of focus involved, it is orderly, and the classroom is quiet. If I were being more critical, I might address that the students are more interested in just about anything else in their line of sight, lethargic, complacent, and disengaged. In fact, at some points I might think that perhaps someone was piping subliminal elevator music into my classroom.

While observing my students, I quickly learned that they had interesting patterns established in regard to raising their hands. The most interesting thing to me while watching the video tapes was that many of my students would raise their hand to speak, but as soon as I chose a student to speak, the other students automatically appeared to disengage. It was as if they realized that they were not the chosen one therefore not required to respond. Remembering that my goal was to increase conceptual understanding and provide opportunities for my students to be actively involved, I knew a change was in order.
Student Interactions in a Small Group Setting

The students seemed to respond much more enthusiastically when interacting during small group activities and discussions. Their interactions during these activities were more reflective of what I had observed during their informal interactions. They appeared to be more engaged, active, and participatory. Unfortunately, the noise level in the classroom was at times high.

Student Interactions in Context of a “New Norm”

When the class began to participate, within the context of a new social norm, in establishing the sociomathematical norms in the classroom, their dialogue took on very different characteristics than the traditional classroom setting. By allowing students to talk to each other, an alternative was offered that combined the best of both strategies. Children were active and more participatory, but the level of noise in the room was lower. Children were focused, but not passive. They were able to participate in class discussions in which all were involved.

Changing Classroom Norms

I found that when students were given the ability to talk directly to one another without first needing to raise their hands, several things happened. First, students seemed to have a reason to stay engaged in the conversations. They knew that they would have an equal opportunity to share their ideas.
Within the context of this setting, they appeared invigorated and excited to converse with their peers. Most importantly, they were beginning to understand that mathematics was now something to explore. Perhaps they could see that getting correct answers was not as important as sharing ideas and exploring the mathematical concepts.

It seemed that the mathematical content became accessible to all the students just because they began to take control of their learning. I was no longer the teacher doling out information that their brains could either absorb or ignore. Now they were able to experience what their friends were thinking and there were no barriers between themselves and the information.

**My “Traditional” Classroom**

When I attempt to define what a traditional classroom looks like, I must focus on the teacher because traditionally, the teacher is the focus and the main source of information. The problem I encountered the first few weeks of my action research study was in regard to my traditional teaching strategies. I was very frustrated as I watched the video taped lessons of my class and noticed some disappointing things.

It appeared at times that students were completely uninterested in the lesson being taught. The same students would raise their hands to participate while other students would sit daydreaming or drifting during instruction. Another thing I noticed was that while one student was answering a question, others would sit with their hand up. This was an indication to me that although they were engaged in the topic at hand, they were
most likely thinking of what they wanted to say next instead of listening to the student that was speaking. I didn’t like what I saw.

When I focused on the particulars of my instruction, I couldn’t help but realize the reality of the way I was attempting to dispense information. This went against everything I knew about how students learn. One of the most disturbing things for me to watch was a video in which I completely missed an opportunity for students to identify a pattern when subtracting 9 from a number. I actually stood at the front of the class and told them the pattern. On the surface, this might appear to be a perfectly acceptable scenario. However, after asking the students to discuss the pattern, I quickly realized that my efforts were in vain. Not one of my students was able to make the connection after listening to my association and seeing my written examples. I’m sure this is just one of many times that I completely missed an opportunity for students to develop thinking patterns. My teaching, almost unconsciously, was based on the belief that students are empty vessels waiting passively to be filled with information.

Although I define the initial phase of my research as traditional, I recognize some aspects of my traditional teaching that were intended to build a foundation for students to model a different sociomathematical norm. One of the most noticeable techniques I used was to have students show a “thumbs up” if they agreed with a classmate and a “thumbs down” if they disagreed. When a student shared an answer and the class responded with thumbs down, they had to reexamine their work and then decide if there actually was a mistake.
At times, I would call on a lone student with a thumb down while the majority of the class had thumbs up. Often this would result in a student self correcting as they tried to explain why they were correct. On occasion, there would be a lone student that was correct and they usually were immediately successful in changing the minds, and thumbs, of the others in the class as they shared their thought process and strategies.

This encouraged students to challenge the reasoning of their classmates if they thought they were wrong. The expectation was always that they should be able to explain why they felt their answer was correct and I also expected them to explain their thought process to describe how they came up with a particular answer. These initial strategies were not discussed with the students until we specifically addressed the norms in our classroom.

**A New Norm**

During the second phase of the study, I initiated a new social norm in our classroom. During the interview, I had asked the students, “What would happen if you were allowed to speak directly to your friends during math class without needing to raise your hands first?” I purposely asked the question including the words, “Allowed” and “Without Needing”, yet all but two of my students made a comment that they would get in trouble, or have to move their clip. (This is what happens as part of the behavior modification system in the classroom). The students were definitely trained.
Student Dialogue

The establishment of sociomathematical norms did not take as much time as I had initially anticipated. The students seemed to have an innate ability to explain, defend, and challenge reasoning. The classroom dialogue after implementation of the new norm took on very different characteristics than that of a typical second grade mathematics classroom. The following examples will provide a glimpse into some fascinating facets of student learning as they negotiated the norms in the classroom.

Our first attempt to initiate the new social and sociomathematical norm in the classroom occurred the first day after the introduction of our new norm. We had already discussed the new concept of being able to talk directly to one another without needing to raise hands first. We also discussed what exactly that would look like. We spent time discussing how to explain thinking and challenging the work of others.

Because this was our first time actually implementing the norm, I had some doubt surrounding my expectations. I wondered if chaos was about to take over my classroom. I was happily surprised at the ensuing conversation.

The students were asked to answer the following question that was written on the board. “I have 16 ducks. My sister has half as many ducks as me. How many ducks does my sister have?” This did not seem to me to be an extremely challenging question. However, I realized right away that many of the students had not mastered the concept of half.

Jamie: “Well, you know how 3+3 = 6? It is the same thing as 16 because if you take away 3 from 16 you are going to end up at 13. So you can
Ms. E.: “Did you notice that Jamie did not just give an answer? She explained how she got it, too.”

Megan: “Jamie, you see she had 16 and her sister has as many as her. If she gives 6 to her sister, she’d have ten.”

Ms. E.: “Megan, you didn’t really tell her if you agreed or not. Do you have something to say about her answer?”

Megan: “You are right.”

Jimmy: “Well, it would be 26 because I counted up 12 and got, I mean, 27. Twelve is a dozen and then half would be 12.

Ms. E.: “Jamie, does that makes sense?”

Jamie: “No.”

Anthony: “Jamie, maybe if you can give 3 to get 16 then you have 13. If she had half she had 13.”

Mike: “If it’s half as many as 12 and if it is half it is 13 if it is both half that would be 16, but its half as many so you have something that is half of something and it is 12, so that would be 6.

Jamie: “Can I go to the board to share?”

Ms. E.: “That is a good idea. Class, watch and think about if you agree and if you want to ask her a question.”

Sarah: “Can I go to the board?”
I let her go up along with Jamie. The rest of the class watched intently.

Jamie: “And then it is 16 circles, well if you erase 3.”

Ms. E.: “Why erase 3?”

Jamie: “If you take away 3 it will be 13.”

Ms. E.: “Are we trying to figure out 16-what =3?”

Jamie: “No.”

The class was quiet. I told them they didn’t have to be quiet and I told them that they could tell her what they thought.

Sarah: “8+8=16. She could give 8 to her sister and still have 16.”

Jimmy: “Both of them are not right. If one dozen is 12, then you have to add up 12 to get a half. People are saying take away and I think you have to plus.”

Ms. E.: “Two things; one, you are doing a good job talking one at a time, two, I notice who you are talking to. (Me) I don’t want you to talk to me. Talk to each other.”

Mike: “One dozen is twelve. And if you add one dozen to one dozen it would be 22. So it can’t be one dozen.”

Jimmy: “That’s not one dozen, it’s 16. One dozen is a half.”

Anthony: “No it’s not.”

Ms.E.: “Do we have a question of what half means?”

Jimmy: After a long silence and two students with their hand up. “Just talk out loud, don’t raise your hand!”
Anthony: “I think Jimmy was going to equal 12 by 6+6.”

Jimmy: “I think I understand what Anthony is saying. You add up 6 to get to twelve.”

Anthony: “Maybe you are trying to say 6 plus 6 equals 12, so half would be 6.”

Sarah: “I think it’s 8 because if you start at 8 and count up 8 then it is 16 or if you stay at 16 and count back 8 then 8. If you add 5 and 3 it would be 8.”

Jamie: “Eight is not half a dozen, half a dozen is 6. I said 12 before, but I change my mind because 12 is a dozen.”

Anthony: “I think you’re wrong because 6+6 isn’t 16.”

Kelly: “Sixteen minus eight equals eight, so that is why it is 8 not 6. I think Sarah is right.”

Ms. E. “I think you are doing a fabulous job. Someone that hasn’t talked, tell me what that means that you’ve not said anything. Raise your hand if you didn’t say a word during this discussion.” *(I counted 5 children with their hand up.)*

Ms. E. “Raise your hand and tell me why.”

Sharisa: “I was thinking.”

Tessa: “I was thinking.”

Bella: “I was thinking of what they were doing and trying to figure out what was right.”
Rose: “I was thinking, too.”

Ms. E.: “Raise your hand if you absolutely know what the right answer is.”

*I count 9 children with their hand up. This is a little more than half of the class.*

Ms. E.: “Write your answer on your slate and cover it. Write based on what you think, what you heard, or what you know.”

I wanted to know if they actually learned anything. I was curious to know if the preceding dialogue only confused things because the students had seemed to cover many different numbers and thoughts. Part of me began to question the merit of allowing them to tell everything that they were thinking. I wondered if that would have a negative affect on other students if they caused them to consider “wrong” answers.

The students each showed me the answer written on their slate. Because this was the correct answer, I was surprised and extremely relieved to see that all but three of the students had the number 8 written as their answer. I did not tell them that it was correct. I noticed that Kim had recorded the number 19. Tessa recorded 13. Jamie recorded 13.

Ms. E.: “We don’t all have the same answer so we need to talk to each other.”

Jamie: *To Tessa,* “Because thirteen take away eight is not half. If it was half it would be like, I don’t really know, but I don’t know.”

Ms. E.: “Tessa, answer something back. Class, when someone says something you should answer back.”

Sharisa: *To Tessa,* “Why did you write 13 for your answer?”

Tessa: “I don’t know.”
Kelly:  “Tessa, do you think Jamie is right?”

Mike:  To Tessa, “Did you guess?”

Tessa:  “No.”

Anthony:  “Because ‘sixteen’(*With emphasis*)… half would be oh, I don’t

know…, ‘8’?” *He said this with a lot of attitude.*

Tessa:  “I’m thinking.”

Ms. E.:  “Jamie or Kim, do you have anything to say?”

Kim:  “I counted up 3. Sixteen plus three equals nineteen.”

Ms. E.:  “The question is not my sister has 13 ducks, I have 3 more. That

would go with your number sentence. Remember, the question is

I have 16 ducks my sister has half as many ducks as me.”

*Megan drew 16 ducks on the board in two rows of 8 then counted.*

Megan:  “Eight is half of 16.”

Sarah:  *Now up at the board referring to Megan’s picture,* “I put some on one

side and some on the other to match.”

Ms. E.:  “Does that picture show half of 16?”

*The class agreed.*

Ms. E.:  “You just explained to each other. First you got an answer and then

you explained. If you got it wrong is that ok? Yes, if I can say why,

then someone can help me. You are off to a great start. As we do it

more it will be more comfortable. How do you feel so far?”

Sharisa:  “I have it in my mind but can’t get it out.”
Jimmy: “I like it.”
Jamie: “I feel shy.”

It was amusing to me that this comment was coming from one of the students that talked the most. Perhaps she was referring to her difficulty in coming up with the correct words or explaining herself. From personal experience this is not at all a shy child.

Sharisa: “It feels good.”
Ryan: “I like that my hand didn’t get tired.”
Sarah: “It’s hard because it is something new.”
Ms. E. “Show me a thumbs up if you like it, a thumbs down if you don’t like it.”

There was just one thumb down. I wondered why this student did not like it. When I asked her to tell why her thumb was down, she gave the following response.

Jamie: “Sometimes I get nervous trying to explain.”

The students demonstrated an ability to flexibly apply the reasoning of others into their own work. This was a sign to me that they were indeed exhibiting conceptual understanding through their dialogue. As a class they worked together to explore what it meant to find half of a number.

By observing their interactions, I was able to assess their understanding of the concepts involved in the number sentence. This provided information to me about their reasoning that would not have occurred in the context of a traditional teacher led discussion. It was very promising that all of this happened in their first attempt at the new
norm. The level of conceptual understanding being exemplified in these types of discussions was apparent throughout the study.

Another example of dialogue between students that showed that development of conceptual understanding occurred the next week. Our class was finishing a lesson on using a bar graph to organize information about how many pockets the children had in their clothes (Figure 1).

![Graph of student pockets](image)

**Figure 1: Graph of student pockets**

This was a follow up lesson from the lesson the day before in which they determined the median for the number of pockets in their clothes. This bar graph was in
their math workbook. They were using the chart to answer questions about the number of students with varying numbers of pockets.

I then asked the students to determine the total number of pockets in the whole class. I thought this would be a challenging task and expected them to need time to find the answer. I was extremely surprised when Peter raised his hand. He had already calculated the answer. I suppose it was natural curiosity that led him to find the answer to a question I had not even asked. The resulting conversation and the student dialogue that ensued demonstrated some interesting aspects of student dialogue in the context of a new norm.

Ms. E.: “How do you have it already?”

Peter: “I counted the boxes.”

Ms. E.: “When did you do that?”

Peter: “A few minutes ago.”

Ms. E.: “What did you come up with?”

Peter: “18.”

Ms. E.: “Does anyone have anything to say about that?”

Jamie: “Your answer is correct because if you go each row and you counted the boxes and did you go back to make sure?”

Peter: “Yes.”

Megan: “You are correct.”

Sarah: “I think it is 17 because if you add 2 to 4 it equals 6 then you add one to 6, it equals 7, so if you add.” (She stopped.)
Ms.E.: “Did you catch a mistake?”
Sarah: “Yes.”
Ryan: “These are all zeros so they are all 13.”
Ms.E.: “Would you explain that to everyone?
Ryan: “These are 0 pockets and Ms. E. asked how many in all and yesterday
there were 1,2,3,…13. So that is 13.”
Megan: “You are correct.”
Ms.E.: “Megan, you said Peter is correct.”
Ms.E.: “Peter, how many did you say?”
Peter: “18.”
Anthony: “I agree with Peter.”
Mike: “I agree with Peter.”
Ms.E.: “Peter, what do you think about what Ryan just said?”
Peter: No answer.
Ms.E.: “Ryan, maybe start with what he said, then say what you are saying.”
Ryan: “Eighteen is not right because zero pockets, you’re counting those and Ms.
E. said how many pockets in all of the whole class and yesterday 5 people
had 0 so you weren’t counting the zero.”
Anthony: “Can I go over there (Ryan’s desk) Ms. E?”
Anthony: Now standing at Ryan’s desk, “1,2,3,…18.” He counted the numbers of boxes
on Ryan’s chart.
Ryan: “Yeah, but these are 0 pockets.” He pointed to the column showing students with 0 pockets.

Anthony: “I found all of those. I counted…and it equals 18. It is not 13 it’s 18.”

More students joined in and said, “We don’t count 0.” Although I had encouraged the students to speak one at a time they were obviously really excited and motivated to share what they now began to understand. I was happy to see their passionate response.

Jimmy: “Anthony, I think what you meant is that these were pockets and you thought these were pockets, too. But not everyone was wearing them. Say if you erased them then how many pockets would you have then?”

Anthony: “Ok, I agree with Ryan now.” He quickly understood when Jimmy said it like that.

Ryan: “There are 0 pockets, so you don’t count 0.”

Sharisa: “I don’t agree because I counted 18 groups.”

Ryan: Now at her desk. “You don’t count the groups that are above 0 because there are no pockets there.”


Anthony: “No, let me show you. You don’t count the zero’s 1, 2, 3…13. Don’t count the 0’s. There is no zeros.”

Sarah: “Actually, I think there are more than 13 because each box is pockets.”

Ms. E.: “Explain to the class.”

Sarah: “This box wouldn’t be counted one, because that is a two pocket. Then there would be another two pockets and then four pockets…” She went on
while the rest of the students chimed in with a resounding, “OOOOOH!” They then proceeded to address this more complicated addition problem.

Through this discussion several important things happened. 1) Students were actively engaged in meaningful conversation that was not manipulated by teacher control. 2) Students were able to explain their reasoning and challenge the reasoning of their peers. 3) Students not only corrected themselves after realizing they were wrong, they actually proceeded to teach other students. Each of these has an implication for student learning and the environment of the classroom.

Overall, student interaction in these types of discussions demonstrated that they were initiating sociomathematical norms as the study progressed. For example, they were becoming aware of the need to negotiate understanding in the classroom. They were beginning to demonstrate ownership of their mathematical thinking.

It was obvious that students began to see errors as opportunities rather than something to be avoided. There seemed to be a meaningful challenge provided that brought their understanding to a new level. They also seemed to value the process of guiding other students. It is important to note that I did not, at any point in the study, teach these strategies. Students seemed to have a natural ability to identify and address what was necessary to bring others to share in their understanding.

**Student Journal Writing**

In the beginning of the school year I established a routine with the students. Each morning they copied a math message from the board that was related in some way to the
math topics we were studying at the time. The students were asked to show their work, explain their thinking, and be prepared to share their work with the class later in the day.

Throughout the study, I expected students to be able to explain their thought processes to other students. They did this through dialogue as well as in their journals. I found that many times it seemed easier for them to explain their reasoning through pictures rather than by using words. This was evident when they went to the board in the front of the room as well as when they attempted to explain their reasoning in their journal. This was another opportunity for me to identify areas of weakness for individual students.

**Initial Journal Entries**

Often, in trying to explain something on paper with words students would use statements like, “I know I am right because I figured it out” or “I know this is right because I used my head”. This seemed to occur more frequently in some journals than in others.

These types of explanations also seemed to occur more often in the beginning of the study than towards the end. These data suggest that students may have developed the sociomathematical norm of what is a good explanation as they had more opportunity for direct dialogue with peers.

For example, in the beginning of the study, the class was asked the following question. “Silvia has 17 CDs. Mark has 8 CDs. How many more CDs does Silvia have than Mark?”
When Jimmy attempted to solve this in his journal he had difficulty coming up with an explanation (Figure 2). Instead of discussing the process, he simply stated that he counted to find the answer. This example was reflective of the work of many of the students. They did not always understand the difference between this type of explanation and one that would defend their answer.

Figure 2: Jimmy demonstrated difficulty explaining his reasoning in his journal.

Jimmy had similar difficulty during the study when he was trying to understand mathematical concepts presented by his peers. Throughout the study, he seemed to need a little more time than others to develop conceptual understanding. He was one of my students that worked very hard to build that understanding. He was also one of the students who showed extreme enthusiasm and a desire to help others once he mastered a concept.

Emerging Journal Entries

In contrast to the initial journal entries were the journal entries in which students used their pictures and words to explain their reasoning. It was as if they were thinking of
a picture that would not only mirror their thought process, but also one that would be clear for others to understand. These types of written explanations seemed to occur more frequently as the norms in the classroom changed.

When Sharisa wrote about the CD word problem, she demonstrated how she arrived at the answer by drawing her hands (figure 3). Her picture was a model for her strategy. She was not very descriptive, but it was apparent that she used her fingers to find the answer to the question. Another student would be able to look at the picture of the fingers and relate because of their frequent use of counting with fingers.

Figure 3: Sharisa used a picture of her fingers to show her answer.
Another student had a slightly different way of explaining the process of coming up with her answer (Figure 4). Although she used a picture of fingers, she explained in greater detail how exactly she used her fingers to arrive at the answer of 9. This showed a greater understanding of explaining the method of arriving at an answer rather than using the picture to demonstrate the correct answer as the other student had done.

Figure 4: Rose showed detail in her picture to explain her thinking.

It seemed that the more students became accustomed to sharing their ideas, the better they became at the process. For students such as Lee, Sharisa, Rose, Sarah, Tessa,
Kim, and Kelly there were positive effects that were evident from the data collected. For example, during the end of October, just one month after the onset of the study, the students were asked the following questions. “Which weighs more, a dry paper towel or a wet paper towel? Why?” Each of these students gave an explanation along with an answer.

For example, Tessa wrote about how the two paper towels would look on a balance scale (Figure 5). This example provided a mental picture for the reader. She effectively explained what would happen if the paper towels were placed on the scale.

Figure 5: Tessa used a description of a balance scale to explain her answer.
Kim answered the question in her journal with a great deal of explanation (Figure 6). Her description of the two different paper towels is given. She then compares and gives a reason for the wet paper towel to be heavier.

```
Which weighs more-a dry paper towel or a wet paper towel?
A wet paper towel!
Because the dry paper towel has nothing in it, so it is plane dry. The wet paper towel has water in it so it makes it heavier.
```

*Figure 6: Kim made a descriptive comparison of paper towels.*

Lee explained that a wet paper towel would have water in it (Figure 7). He further explained that water has weight. His written response showed an understanding in the need to explain an answer.
Emerging Link Between Dialogue and Written Journal Entries

When Sharisa answered the question in her journal, she wrote as if she were talking to another person (Figure 8). Her choice of words, specifically when she wrote, “Let’s say you…” suggests that her focus was on sharing her information with others.
Figure 8: Sharisa's journal entry demonstrated explaining a thought process for others.

These data suggest that perhaps the open dialogue provided opportunities for her to develop the skills necessary to explain reasoning to others. The link between the students’ new dialogue patterns and the emerging ability to explain and justify work on paper was worth noting.

The students began to thrive in an environment that fostered active engagement and conceptual knowledge building. When participating in the new norm, they were able to discuss their ideas, justify and modify their reasoning, and positively affect the other
students in the classroom. Their dialogue provided an important outlet for communicating and transferring knowledge.

The students’ math journals were an equally important outlet. Students were required to explain their reasoning through writing and pictures. As they developed their verbal skills, they could then apply them in written form. The journals also provided assistance when they attempted to explain a concept because they had already independently had the opportunity to solidify their explanation.

This combined approach provided information for me as I attempted to make sense of the data I collected. I learned that some of the students that did not write their explanations were very adept at explaining their work verbally. Other students demonstrated the ability to solve problems and offer suggestions on paper, but then had difficulty sharing their thoughts when addressing other students.

There seemed to be a pattern with students that had very strong math skills. These confident students seemed to exhibit the ability to explain their reasoning consistently in their journal as well as when they participated in class discussions. I would classify Sarah in this last category; however, when asked to solve the question, “If you have ten pennies, six nickels, six dimes, four quarters, and two dollars, how much money do you have?” She was able to answer the question correctly in her journal (Figure 9), giving a thorough written explanation, but then she had difficulty explaining her strategy to the class.
Figure 9: Sarah demonstrated her ability to explain her strategy in her journal.

An interesting occurrence was when Sarah attempted to explain her written work to the class. She stated the following:

Sarah: “I think its $400.00. I know its right because 6 dimes plus 40 pennies equals 100, 6 nickels and 10 pennies equals 100 cents, 4 quarters equals 100, 2 dollars equals 200, so 100 plus 100 plus 200 equals 400 dollars.”

*She had obviously forgotten to convert her cents to dollars.*
I was so surprised that she did not catch her mistake as she said it. The other students could not wait to correct her.

Mike: “How do you know it is 400 dollars?”

Before she had a chance to answer, Anthony joined in the conversation. He seemed anxious to offer some clarity. He quickly explained her mistake.

Anthony: “Sarah, 100 cents equals 1 dollar, then add the rest and it is 4 dollars.” He emphasized the word dollars, probably in an attempt to bring her attention to the mistake.

Sarah seemed to quickly understand what she had done wrong. It seemed that although she appeared to have a firm grasp of money concepts, she had a misconception about converting cents to dollars. She had recorded the correct answer in her journal using cents. She did not seem to understand until corrected by a classmate that she could not simply substitute the word dollars for cents. If she had not shared her process with the other students, I would have looked at her journal and thought she was correct.

It was only through dialogue with her peers that the misconception was noticeable. It was also within this context that the other students had the opportunity to assist her by giving an explanation and support that would have otherwise been missed. It is interesting to note that Mike asked her how she knew she was correct. I wonder if he thought this would help her find her own mistake. Anthony had a different strategy. He provided a great explanation instead of simply telling her she was wrong or giving her the correct answer.
Another student demonstrated conceptual understanding in both her journal and her verbal explanation. She was able to explain her strategy for counting the money with both a picture and words in her journal (Figure 10). She methodically added each separate amount to reach the total.

Figure 10: Rose had the ability to justify her work in her journal.

When she explained her work to the class she stated the following:
Rose: “I know I’m right because if you count 2 dollars and add 1 dollar, that’s 3 dollars. Add 60 cents, that is $3.60, then add 40 cents, so that equals $4.00.”

Before she addressed the class, she had organized the money in stacks by value on her desk. She pointed to the neatly stacked money as she spoke. She seemed very confident and self assured as she explained how she arrived at the total amount.

**Final Journal Entries**

By the end of the study, the students were becoming very descriptive in their math journals. They were able to state an answer along with an explanation of how they got the answer. One of the last journal entries in my data collection was as follows: “Three children share twelve pennies equally, how many pennies does each child get?” The examples that follow show how two students were able to explain their work in their journals.

Tessa did a great job of coming up with a strategy for solving this problem (Figure 11). She effectively shared her strategy. She could have been more descriptive if she would have included the picture in her journal. It is possible that either she ran out of time that particular morning, or perhaps she felt that her explanation was sufficient.
Figure 11: Tessa shared a strategy for solving a word problem.

When Jimmy wrote in his journal, his focus was on describing his strategy (Figure 12). He provided an explanation of why he was correct. He also demonstrated that he understood he would need to have three groups and that if he counted by threes he would be able to determine how many each child would get.

Figure 12: Jimmy explained how he counted groups to solve a word problem.
Summary

The data revealed a wealth of information about the building of conceptual understanding through dialogue that occurred in the context of a non-traditional norm. Students were able to talk directly to each other to share their work, explain their reasoning, and challenge the work of others. In this setting, students began to value the process involved in learning mathematical concepts. They demonstrated the ability to renegotiate their thinking and to positively affect the acquisition of concepts for other students. The quantity and quality of their dialogue was an important aspect of their learning. In the following chapter I will review key factors of the study and highlight implications as well as recommendations for future study.
CHAPTER 5: CONCLUSION

**Introduction**

I was anxious to see what would happen when I challenged the traditional classroom norms with my second grade students. I was able, through an action research study, to answer the important questions, “Would I notice a difference in the quantity and quality of dialogue in my mathematics class if students did not need to first raise their hand before speaking?” and “Would students demonstrate conceptual understanding during these discussions?” In this chapter I will review the results of my study, explore implications, and offer recommendations for future study.

**Results**

I found that the amount of student dialogue within my second grade classroom increased when students were given the ability to speak directly to each other without first needing to raise their hands. Furthermore, the quality of the dialogue during our mathematics class changed as students began to exhibit true understanding that could be defined as more conceptual than procedural in nature. Students were able to modify their reasoning as they explored mathematics with their peers.

Within the context of this new norm, students were more participatory and involved with classroom discussions. They developed mathematics skills that went beyond regurgitation of rules and the ideas of the teacher. As students gained knowledge through the discussions with their peers, they learned that they all could contribute in
some way to the knowledge base of the class. The teacher was no longer seen as the only one with the ability to impart knowledge and student ownership of ideas was evident.

**Implications**

Research reveals the importance of building conceptual understanding in relation to mathematics (Jaworski, 1996; Cobb, Yackel, & Wood, 1992; McClain & Cobb, 2001; NCTM, 2004; Perkins, 2003; Von Glasersfeld, 1995). Furthermore, studies have shown that mathematical conceptual understanding is fostered in an environment rich in student dialogue (Cobb, P., Yackel, E., & Wood, T., 1992; Kazemi, E., 1998; Lo, J., Wheatley, G., & Smith, A., 1994, Yackel, E., 1996; Yackel, E., 2001). Within the context of classroom discussions, students develop mathematical thinking skills as they negotiate the norms in the classroom (Kazemi, 1998; Kazemi & Stipek, 2001; Lo, Wheatley, & Smith, 1994; McNair, 2000; Peressini, & Knuth, 2000; Silbey, 2004; Stephan & Whitenack, 2003).

If students show more conceptual understanding when they are involved in classroom discovery through interactions with other students (Lo, et al., 1994) then our traditional classroom needs to be reevaluated. If we expect our students to graduate from our school systems ready for today’s workforce, then we need to give them the skills that they need to succeed. Students will be required to share their understanding and to apply knowledge in a multitude of situations.

In my study, I created a different learning atmosphere. My focus was on building and enriching conceptual understanding. Communication was also emphasized. This
provided the active involvement recommended for building their conceptual understanding. My findings support the research in regard to the importance of dialogue, constructivism, and the need for a change in the role of teacher and students. Furthermore, I found that the implementation of a new sociomathematical norm had additional benefits. An outsider walking into my classroom would probably be taken aback by the high level of verbal skills being used by seven year olds as they passionately defended their thinking and attempted to assist their peers in knowledge building.

This causes me to feel that it is no longer sufficient to simply deliver instruction. We have to compete with the information overload that prevails in the lives of our students. They are not supposed to passively absorb our thinking. We need thinkers for tomorrow and that will not happen if we do not allow it today.

Some of these implications may seem lofty, but the alternative to lofty inspirations is complacency. How much of what prevails in classrooms these days is influenced by complacency? It seems that by simply evaluating what is important, teachers can begin to make positive changes occur in the classroom.

**Limitations**

Variations in student achievement, student motivation, and self confidence, not to mention professional roadblocks, some of which were hard to identify, had a direct influence on my action research study.

Students vary considerably from one class to another. This must be taken into account when analyzing the data from this study. Although my students were placed
heterogeneously into my classroom, the demographics of the school have a direct effect on the overall make up of my class. The students in my class might have an advantage over other students because in general, they have parents that support their efforts. I was able to see immediate results when allowing my students open dialogue. It is impossible for me to generalize these results to different students.

Teachers are as individual as their students. Implementation of programs and curriculum can vary greatly from class to class. Teachers also support a hidden curriculum in their classrooms. Power relations play an important part as teachers make decisions. I was willing to give up control of my class and to challenge tradition that has been engrained in all that I do. I was able to do this because my underlying belief was that students should have the opportunity to build conceptual understanding. I did not feel that my job was to supply students with the information required by the text. As I attempted to implement a new norm with my students I was forced to examine my practices and rethink the motivation behind my teaching methods. The fact that teachers have differing expectations and philosophies that could influence the outcome, would be a limitation in this study.

**Recommendations**

The results of my study are very promising. I found that students can learn without knowledge being supplied as if it were a tangible object being passed from teacher to student. My students seemed to be more motivated to become engaged and to
stay engaged in mathematics discussions when they all had an equal opportunity to share their ideas.

Based on the results of my study I would recommend three things for the future.
1) Teachers could evaluate their current practice in regard to implementation of constructivism. 2) Students could be more involved in discussions as teachers turn over control long enough to allow them to construct their own knowledge. 3) Related studies could show the effects of open dialogue throughout the curriculum.

**Role of the Teacher**

If teachers desire to build the conceptual understanding of their students several things must take place. First, teachers need to examine their role in the classroom. It may require a paradigm shift resulting in challenging the system in which they have become accustomed. Teachers have the ability to greatly impact the lives of their students, and that importance cannot be underestimated. When teachers begin to focus more at concept building through interaction and discovery on the part of their students, they will see positive change.

A teacher conducting action research might benefit from keeping a personal journal. This is one aspect of my study I wish I could rectify. In the future, I will keep such a journal in hopes of being able to review day to day experiences and personal thoughts throughout the study. This would provide additional insight into some of the underlying issues surrounding teacher change.
Second, teachers must become proactive as they redefine their role in the classroom. Teachers should embrace change as they recognize the changing nature of their profession. Our students are not the same as the students of the past, yet many or our classrooms are eerily similar to the classrooms in which we were schooled. Teachers should recognize that their role, their classrooms, and their methods should change as the students, the demands of our society, and the world in which we live changes.

Instead of relying explicitly on the text book to guide instruction, teachers could allow class discussions to guide instruction. “The text of a mathematics classroom discussion is as important as the written text provided by textbooks and teacher handouts” (McNair, 2000, p. 198). If the mathematics discussions are important to student understanding, then changes should be made to ensure the implementation of these discussions.

Finally, teachers should begin making changes in regard to student participation. If teachers consistently place emphasis on students that can supply correct answers students will recognize the hidden agenda of the teacher. Students will supply correct answers when they can, and stay quiet when they are unsure.

As an alternative, teachers can place emphasis back where it should be; on student understanding. If mathematics skills are taught conceptually, the students will recognize, as my students did, that learning is a process. It is something in which I expected them to be actively involved.

When the classroom environment exemplifies learning in this way, students see that misconceptions are not to be hidden or avoided. Working together in this
atmosphere, both teachers and students can help address misconceptions and students can benefit from the work of others. At first, students may balk at the idea of having to think. However, the reward for students outweighs their initial discomfort.

**Role of the Student**

I had noticed before beginning this study, some interesting patterns of dialogue in the classroom. It seemed to me that students that were unsure of their mathematical abilities were usually very quiet and would not willingly participate in discussions. At the same time, students that were stronger with their mathematics skills were very vocal. At times these students could easily explain why their answers were correct. However, many times they seemed to feel it was unimportant to share how they arrived at answers or would have difficulty coming up with a thorough explanation.

When a traditional social norm was challenged, the dynamics in the classroom changed dramatically. The students that were unsure of their mathematical abilities seemed to be more comfortable sharing in this new environment. Perhaps one of the reasons for this is that they saw their more advanced peers having the same struggles explaining their work. They also began to notice that the main focus of our discussions was no longer on arriving at correct answers. With the focus clearly on the process of explaining their thinking and helping others to understand, the mathematics content became more accessible. This would suggest that students should be more involved in classroom discussions. If they recognize the need to actively participate, question, and
influence others, they can positively influence the building of conceptual understanding for themselves as well as their peers.

Our students are trained at an early age to be passive in the classroom. They have expectations that place the teacher in the foreground. Their own participation at times is secondary. It seems that students have become so accustomed to this that they do not even question it. During the final interview, a student gave a thought provoking answer to the question, “What happened when we changed the rule in our class and you were allowed to talk directly to your friends without needing to raise your hand first.” He started by saying, “It’s pretty cool.” He then went on to elaborate with, “I never got to do that without raising my hand. But I needed to get used to it and when it’s the end of the school year, I’ll have to get out of it because if I try to do it (Talk without first raising hand) in math class next year, then I might get a bad report card.” When I first heard his response I thought it was funny. When I thought more about it, I thought it was really sad. It seemed like such a shame that this student, at the age of seven, already recognized that free sharing, even if it was “Cool”, was not likely going to happen again in school. He obviously felt that what he had experienced was an isolated incident; a phenomenon that would not likely occur again. His response exemplifies an important point. It seems like he identified a serious flaw in our educational system; that he may not be allowed the experience of developing conceptual understanding through discussions with peers. Even a second grader can grasp that our educational system is just not designed for the active participation of students.
My recommendation would be for students and teachers to work together to create a different scenario. Future research could provide students with opportunities to reestablish social and sociomathematical norms in mathematics classes for more than one isolated school year. This would provide a more in depth examination of the underlying issues involved in the establishment of social and sociomathematical norms.

**Dialogue Throughout the Curriculum**

“Students learn how to discuss mathematics as a group and how to make sense of mathematical ideas as individuals by having the opportunities to discuss and make sense of different explanations” (Lo, et al., 1994, p.30). My study supports this claim. The students in my class began to build their understanding as they were given opportunities to hear others. It is equally important for students to have these types of opportunities as they attempt to make sense of ideas in all subject areas.

My students were able to quickly adjust to the idea of speaking directly to their classmates without first needing to raise their hand. After all, that is how they were accustomed to talking to their peers. Perhaps they were just taken aback by the thought of a teacher actually allowing it as they did something as formal as learning.

Although it was different than anything they had experienced in their school career, they seemed very comfortable applying their new norm in other subjects besides the mathematics we were focused on for the study. I found my students discussing reading strategies and phonics rules intermittently. They seemed to feel it was natural to help a classmate learn what they knew.
Students can learn to be involved in this type of natural dialogue across the curriculum. When students learn the important skills necessary to participate in open dialogue with classmates they can become empowered by knowledge and natural curiosity. When they are encouraged to talk directly to each other without first needing to raise their hand, they learn that knowledge can be freely exchanged. They learn that they can teach others and refine their own thinking as well. Knowledge is no longer something to keep hidden, it is something to share.

**Summary**

I learned several important things during the course of my study. The most thought provoking was the idea that there were underlying currents in my classroom that I would never have recognized had I not conducted the study. I liken it to an experience I had many times growing up near the west coast beaches. I would swim out into the Gulf of Mexico and be able to spot my brightly colored umbrella that marked where my blanket was left on the beach. If it were not for that umbrella, I could have easily lost my way after being carried by the current, causing me to walk for miles to arrive back at my blanket. I consider the umbrella to represent my philosophies and beliefs about students and learning. The current that pulls me further from the beach would represent the daily rituals, mandates, and underlying issues and expectations that surround my profession. I have learned that like the bright beach umbrella, my beliefs and the ideas that are important to me have the ability to guide my decisions and to keep me from getting off course. I wish to be the type of teacher that stays true to what is best for the students. I
feel that finding ways to encourage conceptual understanding in my students is a great place to start.
APPENDIX A: INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL
August 10, 2005

Lisa Egedoerfer
849 Reedy Cove
Casselberry, FL 32707

Dear Ms. Egedoerfer:

With reference to your protocol #05-2741 entitled, "The Effects of Different Sociomathematical Norms on Second Grade Dialogue" I am enclosing your records the approved, expedited document of the UCFIRB Form you had submitted to our office. This study was approved by the Chairman on 8/1/05. The expiration date for this study will be 7/31/06. Should there be a need to extend this study, a Continuing Review Form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator. Please notify the IRB when you have completed this study.

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

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

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

Cordially,

Barbara Ward, CIM
IRB Coordinator

Copy: IRB file
Juli Dixon, Ph.D.

BWjm
APPENDIX B: PRINCIPAL APPROVAL
Dear IRB Coordinator,

Ms. Lisa Egendoerfer has notified me of the action research project she would like to implement in the fall of the 2005-2006 school year with her second grade students. Ms. Egendoerfer will study the effects of changing mathematical norms on the amount of student dialogue.

I have reviewed the letter Ms. Egendoerfer will be sending home requesting the participation of her students. She does note their grades will not be impacted should students elect to not participate in the study.

I authorize Ms. Egendoerfer to conduct her proposed research project with her students beginning September, 2005.

Sincerely,

[Signature]
Dr. Brenda Cunningham
Principal
APPENDIX C: PARENTAL CONSENT FORM
Dear Parents,

August, 2005

I am writing to request consent for your child to participate in a study that I am conducting in our classroom this year. I am currently working as a Lockheed Martin Scholar towards a Master’s Degree in Mathematics and Science Education at the University of Central Florida.

I will be researching classroom dialogue during mathematics instruction. The purpose of this research is to determine if changing the norms in the classroom will result in more conceptual understanding and discussion. The research will begin in September and end some time in December. Students will experience typical mathematics instruction with an introduction of an opportunity to build mathematic communication skills.

There are no anticipated risks, only the potential benefit of participating in a study that will help build an understanding of learning in our classroom. The identity of the students will be held confidential. I will be using pseudonyms in written documentation and during discussions with peers and my advisor. I will be using video recording and voice recording for data collection. The video will be seen only by my supervisors and will be destroyed at the conclusion of the study.

Students will be interviewed at the beginning and the end of the study about their participation in class discussions. They may choose during the interviews to not answer any of the stated questions.

Compensation will not be provided, however, I will be happy to share the results of my study with you and with the students.

Participation in this study is not mandatory and will not influence student grades in any way. You and your child may withdraw consent at any time. If you have any questions about this research project, please call me at (407)249-6410 ext. 2269. You may also contact my faculty supervisor, Dr. Juli K. Dixon, at (407)823-4140. Questions or concerns about research participants’ rights may be directed to the UCFIRB Office of Research, Orlando Tech Center, 12443 Research Parkway, Suite 302, Orlando, FL 32806. The hours of operation are 8:00am-5:00pm Mon. through Fri. except on University of Central Florida official holidays. The phone number is (407)823-2901.

Sincerely,

Ms. Egendeerfer

I have read the procedure described above.

I give consent for my child, ____________________________, to participate in Ms. Egendeerfer’s study on mathematics communication.

__________________________ / ____________________________
Parent/Guardian Date

__________________________ / ____________________________
2nd Parent/Guardian Date

I would / would not like to receive a copy of the procedure description.
APPENDIX D: STUDENT ASSENT
Student Assent

Students,

I would like to video tape and record our class. I will use this to learn more about our class discussions. I would like to ask you some questions, too. You don’t have to do this if you don’t want to. You may choose to not answer any of the questions I ask. Would you like to do this?

Thank you!
Ms. Egendoerfer

[Signature]
DATE 2 Aug 2005
APPENDIX E: BEGINNING INTERVIEW
Interview

I'm going to ask you some questions. I'd like you to tell me as much as you can about what I'm asking. Remember, there are no wrong answers.

Do you like math?
Are you good at math?
Do your friends think you are good at math?
Are you comfortable talking about math?
Do you find it helpful to talk about math with your classmates?
If you don't understand something in math class, what do you do?
What does it mean to make mistakes in math class?
Do you like to hear how others solve math problems?
Does this help you?
Is there anything else you would like to share?
Final Interview

Are you good at math?
How do you know?
Tell me what happened when we changed the rules and you could talk directly to your friends during math class without needing to raise your hands first.
Are you comfortable talking about math?
Was the change a good thing?
Do you want to continue doing this?
Did you talk more or less with the new rule?
Was there anything you did not like about the new rule?
Do you think it is important to talk about your math ideas? Why/ Why not?
Now that we have a new rule, do you talk more in small group or in whole group?
Do you like to hear how others solve their math problems? Why/ Why not?
Can you learn math from your classmates or just your teacher?
If you do know how to do something in math, what should you do?
Is there anything else you would like to share?
REFERENCES


