

WHY MIDDLE-SCHOOL STUDENTS STRUGGLE
WITH ACCOUNTABLE TALK®

A Thesis

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DEDICATION

This thesis is dedicated to my parents for their love, endless, support, and encouragement. Thanks for never letting me give up!

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ABSTRACT

WHY MIDDLE-SCHOOL STUDENTS STRUGGLE
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The purpose of this study was to explore why students struggle with the teaching practice called Accountable Talk[®] (University of Pittsburgh, 2010). The researcher implemented Accountable Talk[®] practices in four pre-algebra classes. The objective of this study was to answer the questions: Who are the students who struggle with academic discourse and in what manner do these students struggle? This study took place over an entire school year. There were two phases of this study. The first phase of the study was a survey given to students to measure students' attitudes towards Accountable Talk[®] practices. After student surveys were given, the researcher identified the students who struggled the most with the teaching strategy Accountable Talk[®]. The second phase of the study was to conduct interviews with those students identified during the first phase who struggled with Accountable Talk[®].

After analysis of the data collected through the interview process, this study shows that all students from all academic levels struggle with Accountable Talk® practices. There are many reasons why students struggle with this strategy and the researcher saw three main areas of struggle: one group was uncomfortable with the leadership role that they had to take; a second group was not socially mature enough to engage in Accountable Talk® practices; a third group lacked the mathematical foundation to effectively participate in Accountable Talk® activities.

CHAPTER I

INTRODUCTION

Background of the Study

From Socrates to Dewey to Habermas, dialogue and discourse have represented an opportunity for learners to listen, to develop an understanding, to reflect, and to incorporate alternative ideas (Michaels, O'Connor, & Resnick, 2007; Michaels, O'Connor, Williams Hall, & Resnick, 2010). Since the beginning of formal education, communication and discourse have been a key component in learning. The National Council of Teachers in Mathematics (NCTM) and the California Department of Education (CDE) agree that communication is a key component in teaching mathematics, and both have communication standards as a part of the framework for the mathematics curriculum (CDE, 1999).

In my school district, there has been a big push to implement Accountable Talk® strategies in our classrooms. The school district's goal is for students to be engaged in Accountable Talk® activities for 50% of the class period. Since the researcher was unfamiliar with Accountable Talk®, the researcher started to do some research. Accountable Talk® comes from the Institute for Learning at the University of Pittsburgh, where they have performed extensive research on classroom discourse and its

effectiveness. Accountable Talk® promotes learning through discourse which must be accountable in the following areas: to the learning community, accurate knowledge, and to rigorous thinking (Michaels et al., 2007; Wolf, Crosson, & Resnick, 2006; Sohmer, Michaels, O'Connor, & Resnick, 2003). As the researcher started to implement these strategies in my classroom, the researcher saw many of my students struggle and show resistance. One of my smartest students would always ask if she could do the work on her own, because it took too long to do the work in groups. The researcher started to see students at different academic levels shut down and resist this strategy. What really began to interest the researcher was that when students were asked to talk about the subject matter, they would not want to or they would struggle to do it. However, when it was time to complete a task, they would not stop talking. This trend in my students' behavior piqued my interest as to the reasons why students struggled with Accountable Talk®.

Theoretical Background

Conceptually speaking, Accountable Talk® grows out of Vygotsky's theoretical framework that emphasized "social formation of mind" (Ferryhough, 2008; Imm & Stylianou, 2012; Moll, 1990; Sohmer et al., 2007; Zolkower, & Shreyar, 2007). "Vygotsky is the first modern theorist of cognitive development to place social interaction at its heart" (Smith, Dockrell, & Tomlinson, 1997, 100). Vygotsky's "social formation of mind" can be characterized in terms of three main themes: a) reliance on a genetic method, such

that, mental functions are investigated with respect to their developmental precursors; b) the claim that higher mental functions in the individuals have their origins in social life; and c) the claim that an essential key to understanding human social and psychological processes is mediated by culturally derived tools and signs (Fernyhough, 2008; Moll, 1990; Smith et al., 1997). Vygotsky's theoretical framework emphasizes the importance of social practices and interactions such as orchestrated talk or tasks in academic learning (Fernyhough, 2008; Moll, 1990; Smith et al., 1997; Sohmer et al., 2007).

There are other Vygotskian ideas that are relevant to Accountable Talk®.

First, is the idea of internalization. According to Fernyhough (2008), this concept

involving the gradual and progressive internalization of interpersonal exchanges can help us make sense of the growing evidence that children's understanding of others is developmentally rooted in their experiences of social interaction. (p. 4)

In other words, students in a classroom, participating in a group activity, will internalize and condense the dialogue that has occurred and use it to regulate his or her own solo activity.

A second idea of Vygotsky's, that can be used to help us understand Accountable Talk®, is the zone of proximal development. This concept can be summarized as the difference between what a learner can do without help and what a learner can do with help, either with adult guidance or in collaboration with peers (Fernyhough, 2008; Moll, 1990; Sohmer et al., 2007; Zolkower, & Shreyar, 2007). Vygotsky notes that social interactions essential in whole-class discussion will provide a means by which the

teacher can support student learning (Van Zoest, Stockero, & Kratky, 2010; Zolkower, & Shreyar, 2007). This concept goes hand-in-hand with the Accountable Talk[®] framework. All of the Accountable Talk[®] teaching strategies involve students working with their peers. According to Moll (1990),

Much of research on peer collaboration would answer this question in the affirmative; interaction with more competent peers has been shown to be highly effective in inducting cognitive development. (p. 159)

Statement of Problem

Americans like to think that our top students are the best in world, but this is no longer true (Achieve Inc., 2013). Research has shown that U.S. students are being outperformed in subjects such as mathematics and reading (Achieve Inc., 2013; Petrilli, Scull, & Thomas B. Fordham, 2011). Harvard's Program on Education Policy and Governance (PEPG), in 2010, studied student achievement in mathematics and reading on a global perspective. In this study, PEPG found that 22 countries significantly outperform the United States in the percentage of students reaching proficient levels in mathematics (Peterson, Woessmann, Hanushek, & Lastra-Anadon, 2011). Fewer than 8% of American high school students have sophisticated math skills that can be applied to solve real world problems (Achieve Inc., 2013). This is a huge problem because American students are not prepared to compete in a global economy. A report done by the Partnership for 21st Century Skills found that high school (two-year and four-year) graduates were all deficient in the following areas: writing in English, mathematics, reading

comprehension, written communications, critical thinking and problem solving (Casner-Lott & Barrington, 2006). These are very important skills that all students need to have when entering the workforce.

The CDE, NCTM, the Partnership for 21st Century Skills, and many other organizations advocate that communication is a skill that is essential to the classroom curriculum. According to Bennett (2010), mathematical discourse among adolescents can be very challenging within whole-class settings because social acceptance by their peers is most important. Adolescents wish to avoid embarrassment or appearance of incompetence among their peers (Bennett). This makes it very hard for teachers to generate mathematical discourse among their students. Currently, there little research to show why students struggle with academic discourse in the classroom. Over the course of a school year, the researcher used Accountable Talk[®] in my classroom. Through surveys and interviews, the researcher sought to understand why and in what ways these students were struggling with Accountable Talk[®]. The researcher also hoped to gain a deeper understanding of this problem and to find solutions to this problem. The researcher wanted to understand why my students struggle with communicating with their peers on an academic level. Ultimately, the researcher wanted the students to have 21st-century skills, so that they can compete in the global job market. President Barack Obama said it best in his 2011 State of the Union Address, "We know what it takes to compete for the jobs and industries of our time. We need to out-innovate, out-educate, and out-build the rest of the world" (Peterson et al., 2011).

Research Questions

This study sought to answer the following questions:

1. Who are the students who struggle with the teaching strategy Accountable Talk®?
2. In what manner do these students struggle with the teaching strategy Accountable Talk®?

Purpose of the Study

The purpose of this study was to identify students who struggle with Accountable Talk® and to discover why they struggle with this strategy. Through this study, the researcher was seeking to understand why students, with different academic abilities, struggle with Accountable Talk® activities. The researcher also wanted to measure student attitudes towards Accountable Talk® and find out if there is a connection to why they struggle. Ultimately, as a teacher, the researcher wanted to see if there are changes that could be made in the classroom to help students who are struggling with Accountable Talk® and other such methods that encourage student communication in the classroom.

CHAPTER II

LITERATURE REVIEW

History of Accountable Talk®

Accountable Talk® is talking with others about ideas and work, which is fundamental to learning (Michaels et al., 2007). Accountable Talk® is one of the nine principles of learning that was developed by the Institute for Learning at the University of Pittsburgh. The Institute for Learning was founded in 1995 by Lauren Resnick. Resnick and a team of expert practitioners in instruction and district leadership developed the “principles of learning,” which are nine condensed research-based statements summarizing decades of learning research (Institute for Learning [IFL], 2013). These principles were designed to help educators analyze the quality of instruction and improve teaching and learning. The principles of learning are:

1. Organizing for effort is the idea that everything is organized to evoke and support the assumption that sustained and directed effort can yield high achievement for all students. So all students are taught a rigorous curriculum, in line with the standards, along with as much time and expert instruction as needed to meet or exceed expectations.

2. Clear expectations indicate that specific expectations will be defined for students, school professionals, parents, and community. Descriptive criteria and models of expectations will be displayed so students can use them to refer to or help analyze and discuss their work.

3. Fair and credible evaluations are assessments that students find fair and parents, community, and employers find creditable. Fair assessments are aligned to standards and grading against standards, rather than on a curve.

4. Recognition of accomplishment implies that students will be motivated to work hard by regularly recognizing their accomplishments. This could take the form of celebration of work meeting standards or progress on benchmarks en route of meeting the standards.

5. Academic rigor in a thinking curriculum implies a curriculum that is organized around major concepts and active reasoning about these concepts. Instruction and learning will include commitment to a knowledge core, high thinking, and active use of knowledge at every grade level in every subject. Thinking and problem solving will be the “new basics” of the 21st century.

6. Accountable Talk[®] practices promotes learning that is accountable to the learning community, accurate knowledge, and to rigorous thinking. Accountable Talk[®] practices are serious responses and further develops what members in the group have said that use appropriate evidence to support it.

7. Socializing intelligence calls upon students to use the skills of intelligent thinking and holds them responsible to do so. According to the Institute of Learning (IFL), intelligence includes problem solving, reasoning capabilities, beliefs about one's right and obligation to understand and make sense of the world, and one's capability to figure things out over time.

8. Self-management of learning are skills that include noticing when one doesn't understand something and taking the steps to remedy the situation, formulating questions, and exploring deeper levels of meaning. Students need to be able to manage their own learning through evaluation and feedback from others, bring their background knowledge to support new learning, anticipate learning difficulties and allocate time appropriately, and judge their progress towards the learning goal. Classroom environments should be designed to use self-management strategies.

9. Learning as apprenticeship means to organize learning environments, such that complex thinking is modeled and analyzed, and to provide mentoring and coaching as students undertake projects and presentations of finished work. This kind of environment will allow learners to acquire complex knowledge, practical abilities, and appropriate forms of social behavior.

Resnick and her team continue the expansion of these principles and work toward improvement of education and achievement of all students (IFL, 2013).

Framework of Accountable Talk®

Extensive research has been performed on classroom discourse, which examines the nature of classroom talk and the relationship of talking and learning in a school environment. Within this research, it has been discovered that getting students to talk to each other one-on-one, or as a group, does not necessarily lead to learning (Michaels et al., 2010). Researchers found that it matters what students are talking about and how they are talking.

Accountable Talk® classrooms are filled with students who are seriously responding to one another and further developing what is being discussed in the group. In order to participate, students are required to have relevant and accurate knowledge about the issue under discussion. Students must provide evidence appropriate to the issue, so that their thinking is sharpened, and they are able to use and create new knowledge (Michaels et al., 2010). Accountable Talk® is not discourse that spontaneously springs out of students' mouths.

In order for Accountable Talk® to work, classroom discourse needs to promote learning that is accountable as follows: to the learning community, to accurate and appropriate knowledge, and to rigorous thinking. Accountability to the learning community is a type of talk that can be defined as listening carefully to one another, building on each other's ideas, and asking questions aimed to clarify or to expand propositions (Michaels et al., 2010; Michaels et al., 2007; Sohmer et al., 2003). This type of talk requires participants to provide reasons why they agree or disagree with the ideas presented.

Students, who are accountable to the learning community, demonstrate the following four things: first, students actively participate in several different kinds of classroom talk activities; talk is appropriate in tone and content to the social group, setting, and purpose of the conversation; students allow others to speak without interruption, and directly speak to other students on appropriate occasions (Accountable Talk[®], 2013). Second, students attentively listen to one another; use appropriate body language and eye contact to show attention; make reference to previous speakers when appropriate; make connections to previous ideas; avoid inappropriate overtalk; and be interested in the whole discussion, not just their own (Accountable Talk[®]). Third, students must elaborate and build upon ideas and each other's contributions; talk remains related to text, subject, or issue; related issues or topic are introduced and elaborated; and talk is about issues rather than participants (Accountable Talk[®]). Fourth, students work toward the goal of clarifying or expanding a proposition; revoice, summarize, and paraphrase each other's arguments; make an effort to ensure they understand one another; and clarify or define terms under discussion (Accountable Talk[®]). This kind of talk calls for a certain amount of patience, restraint, and focus on the part of the students and teachers.

Accountability to accurate knowledge, as a type of talk, is based on explicit facts or written text. When a speaker makes a claim, he must have evidence or an explanation to backup what he is claiming. This is when challenges and learning experiences are made, because students are challenging each other and asking for proof (Michaels et al., 2010; Michaels et al., 2007; Sohmer et al., 2003). Students, who are accountable to

knowledge, demonstrate the following three characteristics: first, students make use of specific and accurate knowledge; make specific references to text to support arguments; make clear reference to knowledge built in the course of discussion; use examples or claims from outside knowledge that are accurate, accessible, and relevant (Accountable Talk[®], 2013). Second, students provide evidence for claims and arguments; unsupported claims are questioned and investigated; requests are made for factual information, elaboration, rephrasing, and examples; call for definition and clarification of terms under discussion; and challenge whether the information being used to address a topic is relevant to the discussion (Accountable Talk[®]). Third, students identify the knowledge that may not be available yet, which is needed to address an issue (Accountable Talk[®]).

The third accountability is accountable to rigorous thinking. This type of talk has more to do with building a clear and compelling argument. It requires the participants to link claims and evidence in a logical, articulate, and rigorous manner (Michaels et al., 2007; Sohmer et al., 2003; Wolf et al., 2006). Students, accountable to rigorous thinking, demonstrate the following seven characteristics: first, students synthesize several sources of information; refer to a variety of texts; connect ideas within and between texts; and use previous knowledge to support ideas and opinions (Accountable Talk[®], 2013). Second, students construct explanations; acknowledge that more information is needed; use sequential ideas to build logical and coherent arguments; and employ a variety of types of evidence (Accountable Talk[®]). Third, students formulate conjecture and hypotheses; use “what if” scenarios as challenging questions or supporting

explanations; formulate hypotheses and suggest ways to investigate them; and indicate when ideas need further support or explanation (Accountable Talk®). Fourth, students test their own understanding of concepts; redefine or change explanations; ask questions that test the definition of concepts; draw comparisons and contrast among ideas; identify their own biases; and indicate to what degree they accept ideas and arguments (Accountable Talk®). Fifth, students will generally accept standards of reasoning; use rational strategies to present arguments and draw conclusions; provide reasons for their claims and conclusions; fashion sound premise-conclusion arguments; use examples, analogies, and hypothetical “what if” scenarios to make arguments and support claims; and partition argument issues and claims in order to address topics and further discussion (Accountable Talk®). Sixth, students challenge the quality of each other’s evidence and reasoning; soundness of evidence and the quality of premise-conclusion arguments are assessed and challenged by discussion participants; hidden premises and assumptions of students’ lines of argument are exposed and challenged; and pose counter-examples and extreme case comparisons to challenge arguments and claims (Accountable Talk®). Lastly, classroom talk is accountable to standards of evidence appropriate to the subject matter (Accountable Talk®). It takes a great deal of the teacher’s time and effort to teach students rigorous thinking standards.

Accountable Talk® practices take shape in a variety of forms, such as: whole class discussions, small group work, partner talk, and peer/teacher conferences. In order for students to be able to practice Accountable Talk, there are certain norms that need to

be established by the teacher. A classroom that practices Accountable Talk® must have a “culture” that supports student trust, risk taking, and respect for one another’s ideas (Michaels et al., 2010).

From the beginning of the year, the teacher must create norms for equitable and respectful participation. First, there needs to be a format for taking turns to talk, so that it is equitable to everybody in the classroom. Second, teachers need to use wait time after posing a question, after calling on a student, and after a student gives a response (Michaels et al., 2010). Increasing wait time to at least three seconds has the following effects on students: the length of students’ responses increase, more inferences are supported by evidence, it increases speculative thinking, the number of questions asked by students increase, and students’ confidence increases (Michaels et al.). The classroom environment is key to the success for Accountable Talk® practices.

There are two goals of the teacher when creating a classroom that supports Accountable Talk®. First, the teacher must create a classroom environment in which all students have access to, and can hear, the conversation. The teacher must also make sure the content of the talk is consistently furthering academic learning (Michaels et al., 2010, Michaels et al., 2007). The second goal is that teachers use “moves and practices” to promote accountability to community, knowledge, and rigorous thinking. Teacher’s “moves and practices” that support Accountable Talk® to the learning community are keeping the channels open, keeping everyone together, linking contributions, and verifying and clarifying (Michaels et al., 2010; Michaels et al., 2007). Teacher’s “moves and practices”

that support Accountable Talk® to accurate knowledge are: a) pressing for accuracy, and, 2) building on prior knowledge. Teacher’s “moves and practices” that support Accountable Talk® to rigorous thinking are: a) pressing for reasoning, and, b) expanding reasoning (Michaels et al., 2010; Michaels et al., 2007). An environment that supports Accountable Talk® takes a lot of the teacher’s time and effort, but the learning that comes from this environment is priceless.

Learning Math Through Discourse

The belief that discourse benefits student learning is held by many researchers, teachers, and teacher education programs. When students are talking about mathematics, they are learning about mathematics (Piccolo, Harbaugh, Carter, Capraro, & Capraro, 2008). Over the last 50 years, research has shown that discourse in a mathematics classroom leads to a deeper understanding of the concepts. This brings us back to Vygotsky’s ideas on how we learn through social interactions and that language is the root of all learning (Cirillo, 2013). More specifically, it leads to Vygotsky’s zone of proximal development, which considers the gap between what a learner has already learned and what he or she can achieve when given support from a competent peer or teacher. This, in turn, can be connected to the idea of discourse in the classroom and the benefits of student learning.

According to A. Thompson and P. W. Thompson (1996), discourse causes significant mathematical thinking and is the foundation to meaning insights for student

and teachers. When students talk about mathematics, it helps them develop understanding, learn that there is more than one way to solve a problem, and increase their confidence (Cook, 1998).

Motivating Students Through Discourse

Over the last 20 years, research has shown that using discussions in mathematical classrooms can be very beneficial to students. Studies have shown that discussions can increase student learning, motivate students, support teachers in understanding and assessing student thinking, and shift the mathematical authority from teacher to community (Cirillo, 2013). Discussions held in mathematical classrooms make the students accountable for their own knowledge and engagement in the discussion. Classroom discussion motivates students to be more engaged in their own learning. Middleton and Jansen (2011) suggest that classrooms which have environments where questions, alternative solutions, false starts, conjectures, or any type of contribution are norms that will help the advancement of classroom knowledge. Students in these environments feel more comfortable and courageous enough to contribute to the classroom discussions. "Active participation in a collaborative mathematics classroom, therefore, can have a positive impact on student motivation; 'Knowledge is built. Understanding grows. Relationships with mathematics and with classroom community members develop'" (Cirillo, 2013). When students have the opportunity to be a part of academic discussion, they are motivated to learn.

Communication Standards from the National Council
of Teachers of Mathematics and California
Department of Education

The CDE oversees the public school system and is responsible for the education of more than 7,000,000 children and young adults. The mission of the CDE is to innovate and collaborate with educators, schools, parents, and community to prepare students to thrive in a highly connected world. The CDE has indicated the importance of communication in the teaching of mathematics (Quinn & Wilson, 1997). The California State Standards for Mathematics states that California public school students, by the seventh grade (Standard 2.6), should be able to

use strategies, skills and concepts in finding solutions and express the solution clearly and logically by using the appropriate mathematical notation and terms and clear language; support solutions with evidence in both verbal and symbolic work. (CDE, 1999)

Communication is a key component to teaching and learning mathematics.

The NCTM is an organization for mathematical educators that supports teachers to ensure equitable mathematics learning for all students through vision, leadership, professional development, and research (NCTM, 2000). NCTM has four main goals under the communication standards for all students:

To organize and consolidate their mathematical thinking through communication, to communicate their mathematical thinking coherently and clearly to peers, teachers, and others, to analyze and evaluate the mathematical thinking and strategies of others, and to use the language of mathematics to express mathematical precisely. (NCTM, 2000)

NCTM is an organization that is dedicated to improve mathematics education.

The National Council of Teacher of Mathematics is a public voice of mathematics education supporting teachers to ensure equitable mathematics learning of the highest quality for all students through vision, professional development, and research. (NCTM, 2000)

NCTM has published a set of standards for students in grades K-12 that describes a set of mathematics basics for all students to learn. In these standards, NCTM has a set of communication standards that outlines how mathematics students should be communicating in the classroom. Students should be able to organize, analyze, evaluate, and strengthen their mathematical thinking through communication (NCTM, 2000). According to NCTM, communication plays an important role in helping children build mathematical knowledge. Communication helps form connections between their informal notions and abstract symbolism of mathematical ideas (Moyer, 2000). The NCTM developed these standards to empower students in mathematics, as well as to help guide math teachers to improve the curriculum.

Need for Intervention

The Trends in International Mathematics and Science Study (TIMSS) provides reliable data on mathematics and science achievement of U.S. 4th and 8th grade students, which is compared to that of students in other countries. TIMSS also collects data on curricula, instruction, lessons, and the lives of teachers and students to help understand the educational context in which mathematics and science learning takes place (National Center for Education Statistics [NCES], 2013). TIMSS has been collecting data every year, starting in 1995. In 2011, more than 60 countries participated in TIMSS.

Based on the TIMSS data, the average mathematics score for U.S. 8th graders was 509, which is higher than the international TIMSS average of 500 (NCES). The United States was among the top 24 educational systems; 11 educational systems had higher averages, and 12 were not measurably different. When compared to TIMSS data from 2007, there was no measurable change in the average mathematical score (NCES).

Harvard's Program on Education Policy and Governance (PEPG) did a study of student achievement in mathematics on a global perspective. This study focused on the percentage of U.S. public and private school students' performances at an advanced level in mathematics (Peterson et al., 2011). PEPG found that the United States came in 32nd among the 65 nations that participated. The data showed that 32% of U.S. students in 2011 were proficient in mathematics. According to PEPG, 32 countries outperformed the United States in mathematical proficiency. These studies show that American students are falling behind and will not be able to compete in a global market.

The Partnership for 21st Century Skills, The Conference Board, Corporate Voices for Working Families, and the Society for Human Resource Management completed a unique study on the readiness of high school and college graduates into the workforce. In this study, over 400 employers across the United States were surveyed on skill sets that new employees needed in order to be successful in the work place (Casner-Lotto & Barrington, 2006). The results of this study showed that students performed below average in the written English language, mathematics, reading comprehension, written communications, critical thinking, and problem solving (Casner-Lotto &

Barrington). Even though we know the importance of communication in the classroom, studies have shown that American students are falling short. According to Rotherham and Willingham (2009), a growing number of business leaders, politicians, and educators believe that students need 21st-century skills, in order to be successful. Twenty-first-century skills can be organized in four broad categories: a) ways of thinking creatively, critical thinking, problem solving, decision making and learning; b) ways of working collaboratively and communicatively; c) tools for working in information and communications technology and information literacy; and, d) skills for living in the world, citizenship, life and career, and personal and social responsibility. Again, American students are not meeting communication standards.

Conclusion

From the results of the fifth Trends in International Mathematic and Science study, it's obvious that our nation needs to improve the teaching of mathematics (NCES, 2013). We know from researchers like Vygotsky, and many others, that discourse promotes learning. The CDE and NCTM both have guidelines and standards built around the importance of communication in the classroom. According to NCTM, "Today many students are not learning the mathematics they need. In some instances, students do not have the opportunity to learn significant mathematics ... students lack commitment or are not engaged by existing curricula" (2000). Research also shows that students need to improve their communication skills.

The overarching message of this literature review is that integrating academic discourse into a mathematics classroom is beneficial for student learning, but also that American students are lacking in mathematical and communication skills, and yet there appears to be a gap in the information on why students continue to struggle with discourse and in what ways they study. My study examined these issues.

CHAPTER III

METHODOLOGY

Research Design

The study is designed to examine which students in a pre-algebra class struggle with academic discourse and in what manner they struggle. The researcher used a variety of Accountable Talk® strategies in the classroom every day. Students were engaged in each of these strategies. At the beginning of the fourth quarter, the researcher conducted a survey to measure students' attitudes towards Accountable Talk® practices. Each survey was scored on a five-point Likert scale. From the survey, the researcher chose students to interview in order to gain a deeper understanding of why they struggle. The significance of this study was to identify specific reasons why students struggle with academic discourse and determine potential solutions to their struggles.

Population and Sample Size

This study took place at a suburban middle school with approximately 800 students. The demographics of this school's population was 3.7% African American, 1.8% American Indian, 2.7% Asian, 2.5% Filipino, 11.5% Hispanic/Latino, 0.6% Pacific Islander, and 77.2% white. The school's 2011 academic report card showed an API score of 843. The average math class size was 27 students.

The sample in this study consisted of 116 7th and 8th grade students. From the sample, 17 students were selected to be interviewed. The sample in this study was a convenience sample and the students in the sample were enrolled in the pre-algebra classes that were taught by the researcher. Therefore, the sample was not randomly assigned. The researcher selected three classes that were of similar ability.

Treatment

At the beginning of the year, the researcher set up a classroom culture that supported student ideas, trust, risk-taking, and respect for one another's ideas. In the classroom, the researcher created norms for equitable and respectful participation. The researcher used a variety of Accountable Talk[®] strategies every day to teach the curriculum. The participants were engaged in each of these strategies. The treatment was given to three pre-algebra classes. The treatment was a variety of Accountable Talk[®] practices, including the following:

Whole-Group Discussion

The teacher, in this format, orchestrates talk among a large group of students. The teacher must have a clear academic purpose for the activity and be ready to handle students' misconceptions. Students are expected to contribute their knowledge and to engage in others' ideas. An example of this practice would be a Socratic seminar. A Socratic seminar is a discussion among students in which they are given the opportunity to make value judgments or moral decisions.

Small-Group Discussion

The difference between whole-group discussion and small-group discussion is the size of the group. Teachers and students have the same tasks as in whole-group discussion.

Teacher-Student Conferences

This format focused on one or two students. The goal for this type of talk was to discuss the individual pieces of students' work or ideas.

Student-led Small Group Work and Peer Conferencing

This type of group work is very closely related to cooperative learning. In order for small groups to be productive, the task must be clear and there needs to be cooperative norms to ensure equal participation from all students (Michaels et al., 2010).

Hybrid Talk Formats

These strategies focus on two facets: a) academic rigor, and b) equal participation from all students. The following are examples of hybrid talk (Michaels et al., 2010):

1. Stop-and-talk (partner talk): This type of talk occurs when a teacher is in the middle of a whole-group discussion and students are asked to discuss questions or ideas with one or more partners.

2. Fishbowl: This format involves a small group of students in the center of class while the other students gather around the outside. The students in the center are asked to discuss a topic or address a series of questions, while the students on the outside are

listening and watching the interactions of the students in the middle. During this time, the teacher does not actively participate, but merely observes the students. At different points throughout this activity, the teacher stops the students in the center and asks the students on the outside to comment on what they are noticing about the students' discussion, processing of ideas, reasoning, and so on about the discussion.

3. Student presentation: This format typically requires a student to present his or her solution to a math problem in front of the rest of the class. The student presenter has a certain amount of time to explain his or her solution, and then, the teacher and other students are given time to ask questions and to offer different solutions or suggestions to improve the presentation.

Data Collection

Data collection for this study was done in two phases. The first phase was a survey, and the second phase involved interviews. The researcher used a 14-question, five-point Likert survey with (4 = strongly agree, 3 = agree, 2 = not sure, 1 = disagree, and 0 = strongly disagree) to analyze the students' attitudes towards mathematics and Accountable Talk® (Appendix A). Questions 1, 3, 4, and 7 were designed by researching other Likert surveys on student attitudes towards mathematics. Some of the survey statements were designed to measure each student's attitudes towards his or her success, or lack of success, in mathematics classes. Questions 2, 5, 6, and 8 were intended to determine the amount of motivation students had for learning mathematics. Questions

9, 10, 11, 12, 13, and 14 were designed to measure each student's attitudes towards Accountable Talk®.

At the end of the survey, there were four questions in which students were asked to fill in answers about their feelings towards the Accountable Talk® strategy. The researcher used the data from the survey to help determine which students to interview.

During the second phase, students were interviewed about their experiences with the teaching strategy Accountable Talk®. Before students were interviewed, a consent form was sent home and a guardian signature was required to participate (Appendix B). During the interviews, the researcher asked 13 questions that helped the researcher understand why these students struggle with Accountable Talk® and in what ways they struggle (Appendix C). While conducting these interviews, the researcher took notes, and it was also recorded, so the interview could be transcribed.

1. The first question was designed to get the students educational background. Questions 2 and 3 were designed to understand the students general feeling towards pre-algebra.

2. Questions 4 and 7 were designed to find out if Accountable Talk® practices helped students understand mathematics.

3. Question 5, 6, 8, and 11 were designed to determine why they struggled with Accountable Talk® and in what ways they struggled.

4. Questions 10, 12, and 13 were designed to understand how important Accountable Talk® practices are and how the teacher can help.

Data Analysis

After collecting the surveys, all of the students' responses were analyzed using SPSS (Statistical Program for the Social Sciences), a statistical software package. The researcher first looked at the survey scores that were the lowest and examined them closer. The researcher chose the students to be interviewed, based upon the low survey scores and in consideration of the short answer questions, as well. The four short-answer questions were organized, colored-coded, and placed into a spreadsheet.

For the interview portion, the researcher transcribed the interviews, so this could be easily compared to the notes from the interview. The researcher wanted to be able to compare and contrast the information from the interviews and possibly find common themes. The researcher used a method from Huberman and Miles (1983) to locate themes. The data was classified by sorting and then assembling information together that had similar themes. The researcher gathered information together by looking through finding the similar themes between the students' responses. The researcher used this method, and the help of spreadsheet software, to analyze data (Jeroski, Booth, & Dockendorf, 1992). The spreadsheet was organized into a data matrix (Sagor, 1992) by placing the questions across the top, as column headings, and the coded student's number down the left side, as row headings. Next, the data from the interview transcriptions and notes were placed in the appropriate cells. As Sagor suggested, the researcher color-coded the data so that each participant could be recognized and compared. When using

this format, the answers to each question, delivered by each student, could be easily seen all at the same time.

Using the data matrix, it was very easy to find similarities, differences, and common themes to be explored further. Sagor (1992) suggests that after the data is color-coded, separate documents can be made that contain the common themes. Thus, when a trend, pattern, or common theme is observed, that data was cut and pasted into a Word document. This process highlighted the common feelings of students who struggled with Accountable Talk®. For instance, students responded that speaking academically made them feel uncomfortable, so a document was created. All relevant information, from all interviewees, was placed in this document to be further analyzed. Since the comments are color-coded, all of the comments on this theme can be compared, while maintaining the knowledge of who made each comment.

According to Sagor (1992), the phenomenon of separation of data often reveals aspects that need to be further examined. From the color-coding, it was very apparent that the students who were interviewed felt very uncomfortable when they had to speak in class. Therefore, a closer examination of the interviews was needed to find a deeper understanding of why these students felt uncomfortable. This information was then put into another document. The color-coding format made it very easy to compare how various students responded to each topic. The information from 17 interviews was organized into individual files relating to each of the relevant topics.

CHAPTER IV

RESULTS

Results

The objective of this study was to gain a deeper understanding of why students struggle with the teaching practice called Accountable Talk®. The researcher also wanted to understand why or in what ways these students struggle. The study was designed to have two phases through which to collect data: through survey and interviews.

Survey Results

The survey developed for this study focused on two items: attitudes of students toward mathematics and attitudes of students towards Accountable Talk® practices. Each student was given the survey. The survey was 18 questions long. Questions 1 through 8 were designed to measure students' motivations towards learning mathematics and general feelings about mathematics. Questions 9 through 14 were designed to measure students' attitudes towards Accountable Talk®. A higher rating should be interpreted as a positive attitude toward the learning of mathematics and general feelings about mathematics, and a lower rating should be interpreted as a negative attitude.

Reliable analyses were conducted on each subset of the survey's questions to confirm an alpha value. Nunnally (1978), has indicated that 0.7 is an acceptable reliability coefficient, but lower levels are sometimes used in literature. Table 1 demonstrates the alpha values for each subset, ranging from 0.61 to 0.76. The only subset that had a high reliability was the question that measured the students' attitudes towards Accountable Talk. When examining the Inter-Item correlation of questions 2, 5, 6, and 8, question 2 had a negative correlation with the rest of the questions. Thus, it should have been removed or reworded. Similarly, when the researcher examined the inter-item correlation on questions 1, 3, 4, and 7, question 3 had a negative correlation with the other questions in this subset.

Table 1

Reliability Statistics

Subset	Cronbach's Alpha
Attitude towards mathematics	0.61
Motivation towards learning mathematics	0.63
Attitude towards Accountable Talk [©]	0.76

Table 2 shows descriptive statistics for items related to students' attitudes towards learning mathematics and their general feeling about mathematics. In question 2, 86% of the students strongly agree or agree or strongly agree that they want only the teacher to inform them what is going to be on the test. In question 3 (mean = 2.77), students did not like discussing current topics that they were learning in math class. Thirty-

Table 2

Student Responses to Survey Questions 1-8

Question	% of students	Mean	Mode
1. I think it takes a special talent to do well in math class.			
Strong agree	4	3.03	3
Agree	33		
Not sure	37		
Disagree	14		
Strongly disagree	12		
2. In math class, I like the teacher to teach, discuss, and assign only things that I will later be tested on.			
Strong agree	31	4.02	4
Agree	55		
Not sure	6		
Disagree	0		
Strongly disagree	8		
3. I like to talk to my parents and other family members about topics we are currently discussing in math class.			
Strong agree	2	2.77	3
Agree	20		
Not sure	45		
Disagree	18		
Strongly disagree	15		
4. When I think about all the classes I have taken in middle school, math was one of my favorite subjects.			
Strong agree	6	2.86	3
Agree	26		<i>cont'd</i>

Question	% of students	Mean	Mode
Not sure	28		
Disagree	28		
Strongly disagree	12		
5. One thing I like about math class is that it is just about working with numbers and solving problems.			
Strong agree	2	2.93	3
Agree	32		
Not sure	38		
Disagree	15		
Strongly disagree	13		
6. In math class, I like work that is challenging so that I can learn new things.			
Strong agree	9	3.22	4
Agree	42		
Not sure	22		
Disagree	16		
Strongly disagree	11		
7. Math is one of my favorite subjects.			
Strong agree	8	2.87	2
Agree	24		
Not sure	27		
Disagree	30		
Strongly disagree	11		
8. In math class, even when new concepts are dull and uninteresting I keep working until I understand it.			
Strong agree	18	3.6	4
Agree	53		<i>cont'd</i>

Question	% of students	Mean	Mode
Not sure	13		
Disagree	2		
Strongly disagree	14		

three percent disagreed or strongly disagreed and 45% were not sure about discussing mathematics with their families. In questions 4 (mean =2.86) and 7 (mean= 2.87), students felt strongly that mathematics was not one of their favorite classes. Forty percent or more students disagreed or strongly disagreed with these statements. In question 6 and 8, students were asked about their motivation towards learning mathematics. In both of these questions, the mode was four, which means most students agreed that they liked to be challenged to learn new things, even if the material was dull and uninteresting. The students in this study were motivated to learn mathematics, even if they are not interested in the subject matter. Interestingly, half of the questions in Table 2 had a mode of three, which means that they were not sure about their feelings for mathematics and about learning mathematics. However, it was very clear that many of the students were unsure or disagreed that mathematics was a favorite class.

Table 3 shows descriptive statistics for items related to students' attitudes towards Accountable Talk[®] practices. A higher rating should be interpreted as a positive attitude toward Accountable Talk[®] and practices. We see from the modes in questions 10 (mode =4), 11 (mode=4), and 14 (mode=4) that the most frequent answer for those

Table 3

Student Responses to Survey Questions 9-14

Question	% of students	Mean	Mode
9. I like math more when I am given an opportunity to discuss it with my fellow peers.			
Strong agree	23	3.66	4
Agree	42		
Not sure	20		
Disagree	6		
Strongly disagree	9		
10. I understand the concepts better (or more in depth), when given time to talk to my peers.			
Strong agree	21	3.64	4
Agree	48		
Not sure	17		
Disagree	4		
Strongly disagree	10		
11. The strategy, Turn and Talk, helps me understand concepts more deeply.			
Strong agree	17	3.65	4
Agree	54		
Not sure	15		
Disagree	4		
Strongly disagree	10		
12. I have a hard time communicating with my peers about mathematics.			
Strong agree	15	3.28	4
Agree	37		<i>cont'd</i>

Question	% of students	Mean	Mode
Not sure	26		
Disagree	7		
Strongly disagree	15		
13. I really enjoy working in groups.			
Strong agree	40	4.03	4
Agree	41		
Not sure	8		
Disagree	3		
Strongly disagree	8		
14. I remember more things about the lesson when I get to talk about it.			
Strong agree	22	3.67	4
Agree	51		
Not sure	11		
Disagree	3		
Strongly disagree	13		

questions was that students “agree” that Accountable Talk[®] practices help them to better understand the concepts. In question 13 (mode = 4), 81% of the students agreed or This result is similar to question 2, in which students did not like communicating about mathematics to their families. In question 9 (mode = 4), 65% of students agreed or strongly agreed that they liked math more when given the opportunity to discuss it with their peers. Overall, students liked math more, and had a greater understanding of it, when they had the opportunity to talk about it with their fellow peers.

Table 4 shows some of the interesting responses from the fill-in-the-blank questions at the end of the survey. As the researcher was sorting through the data in question one, the researcher was looking for words that had a negative connotation. The researcher was interested in finding students who were uncomfortable with the idea of working in groups, because these were the students who the researcher wanted to interview. In questions 16 and 17, I received a lot of useful information on some of the things that could go wrong in group-based activities. In question 18, my favorite comment was to have groups comprised of some teachers instead of all kids. All of the comments made by students in this survey were very thoughtful and the researcher learned a lot about my class from these surveys.

Interview Results

The researcher conducted 17 interviews. Each student was given the same questions and was interviewed by the same researcher. Aliases have been given to each student to ensure anonymity and confidentiality. This chapter is divided up into four sections that cover the information provided by the students during the interviews. The first section is Background of Students. This section provides general information about the students and general feelings about school. This section will also describe feelings towards mathematics and their struggles with it. The second section is Accountable Talk® Practices Help or Hurt in Understanding Mathematics. This section determines if Accountable Talk® practices help students to better understand mathematics. The third

Table 4

Student Responses to Open-ended Questions

Question	Responses
15. When asked to work in groups, I feel: _____.	Not thrilled but nervous (6%); worried (6%); pressured (2%); nervous (9%); disliked (7%); not smart (4%); like I don't want to talk (5%); bad and shy (5%); anxious (10%); discomfort (21%); good (11%); normal (7%); fine (7%).
16. One of the things I find challenging about talking in pairs is: _____.	Discomfort (8%); don't like to talk (8%); shy (16%); difficulty trying to understand others' methods (11%); don't like to communicate with people or with people I don't know (5%); difficulty staying on topic (8%); problem is too hard (10%); have to stop to give answers to persons in group (3%); I feel like if I get something wrong..., students will think I am dumb (8%); I don't feel comfortable talking to someone I don't know about a math problem that I don't know how to do (9%); my partner will not talk to me (11%); challenging because math is hard (14%)
17. One of things I find challenging about talking in small groups is: _____.	Not challenging (10%); get more stuff done...especially when smart people are in your group (3%); don't want to get the wrong answer and I feel out of place (11%); I'm shy and I don't like talking to random people (14%); feeling stupid when not knowing how to do a problem (7%); when group members don't pay attention to what we do (4%); not knowing them very well and nervous to talk to them and would rather work alone (8%); being put on the spot when (<i>cont'd</i>)

	I don't have a clue (9%); others in group are just socializing (11%); pressure that if I get the wrong answer; everybody will blame me (13%); I have to explain the problem over and over (4%); the group is so scared to talk about what they think (2%); people don't understand me (3%); don't like working with others (1%).
18. To make me feel more comfortable talking in class, the teacher could do: _____.	Pick own groups (21%); nothing (31%); have bigger groups (8%); pair people with people that seem good pair (9%); groups that have teachers instead of all kids (10%); don't like working in groups (21%).

section is Why Students Struggle with Accountable Talk®. This section covers the reason why students struggle with Accountable Talk® and in what ways they struggle. The last section is Importance of Accountable Talk® in the Classroom. This section covers why the students feel Accountable Talk® is important and how teachers can help with it.

Background of Students

Of the 17 students interviewed, two of them were male and 15 were female. Three of the students who were interviewed were in the 8th and the rest of the students were in the 7th grade. Generally speaking, most of the students like school and enjoy being there. From the interviews, students generally feel that there is a purpose for school, and they know it is important to their futures. Student 2 and student 15 have always really struggled in school. Both of these students stated that it doesn't matter how hard they work, they are always confused and don't get it. Nine out of the 17

students struggle with math for various reasons. Some of the reasons why these students struggle in pre-algebra are the concepts are taught too quickly, the class moves at a very fast pace which leads to little mistakes being made, and many have a hard time focusing in class, and do not understand the material. The other six students are proficient in math and work hard to be proficient.

Accountable Talk® Practices Help or Hurt in Understanding Mathematics

During the interview, students were asked two questions regarding how Accountable Talk® strategies help them understand mathematics. In regards to these questions, students were split into two groups: students who saw benefits in the practice and students who saw no benefits. The reasons students thought this practice deepened their understanding in mathematics were to hear multiple solutions, to get help from peers, to discuss right and wrong answers, to discuss mistakes and how to come to a solution, and to learn new material. Here, student 1 explains why Accountable Talk® helps:

Accountable Talk® helps me understand the math better, because I get to ask my partner for help and, usually, I get the help that I need. I also get to hear lots of different solutions, and I usually learn something new from it. You also get more things done in groups.

Student 1 expresses that hearing other group members' solutions really helps her understand the mathematics. It also gives her more time with concepts. Students who are not sure how to do a problem, or are hesitant, can listen to group members' solutions and

have another way to solve the problem. Students also have more time to process the material and deepen their understanding. Students 8, 9, 10, 11, 12, and 17 expressed similar views to the benefits of Accountable Talk®. Another benefit to Accountable Talk® strategies is students are being able to do and redo problems to try to figure out the mistakes. This process helps strengthen a person's understanding. For example, student 13 stated,

It helps me understand it, because I get to see other people's mistakes and how they got the wrong answer. Then, I get to see how people do it right. Like I said, I get to see what happens, and the process to the wrong answer, and then the right answer. So, yeah, it helps me in that way.

Since this student struggles in math, the process of doing and redoing problems has helped deepen her understanding. The students in this group all agreed that Accountable Talk® helped them in their understanding of mathematics.

However, some of the students interviewed felt that Accountable Talk® provided no benefits at all. Most of these students felt like it was a waste of their time. The reasons students in this group felt that there was no benefit to Accountable Talk® are "It confuses me to hear other people's solutions"; "I don't want to look dumb if I get a wrong answer"; "I have a hard time communicating with people I don't know"; "I shut down and don't talk when I am in groups"; and "It pulls me away from my own work."

Student 7 states,

I struggle working in pairs. I am a guy that likes to work alone and focus. As where if I am working in a pair or group, I feel like I've got to stop what I am doing and help someone else and then go back and forth. It's just a constant back and forth between my work, then help, my work, then help. It just

doesn't help me at all. It's just pulling me aside from what I would learn alone.

This student is in the 8th grade and it is his second time taking pre-algebra. He perceives working in groups as a waste of time and doesn't see the importance of helping others. He is more focused on his own grades. According to student 5, she struggles with working in groups "... because I am the only smart person in the group, and I am teaching the other people." This student is smart, cares about her grades, and likes school a lot. She does not struggle in pre-algebra and is at the top of her class. When asked to work in groups, this student in particular shuts down and doesn't want to participate. Some of these students are not comfortable being the leader in their group and fear that they are teaching their group members the wrong information. On the other hand, there are students who are afraid to even participate in groups, because they do not want to feel dumb. For example, student 2 states,

Accountable Talk[®] doesn't really help me. I feel like if I get something wrong that they understand, they will think I am dumb. I get really confused with other people's explanations and get lost when I am in groups.

Student 2 has always struggled in school and in math especially. This student lacks mathematical confidence. Because of this fact, she will not even try to put herself out there. She doesn't want people to make judgments about her. This student is easily confused and is unmotivated to get help. Student 3 added, "I have a hard time communicating with my peers and have an inability to communicate with some people." This

student is easily confused in math and lacks the confidence to ask questions of her peers or teacher. Student 16 shared similar feelings:

I don't talk to people. I just sit there and sometimes my partners don't even talk to me. I don't like to talk to people I don't know. I am very shy and have a hard time talking, so I usually do not participate in the activity. Sometimes, I shut down and get lost in my head.

This student came into my class during the third quarter. She has always struggled with reading and math. She learns at a slower pace and school is hard for her. The class moved too fast for her and she got left behind. For some of these students, speaking in a group is very difficult for them, and they often shut down when faced with it, while other students struggled with the leadership role they had to take when they were in groups. Regardless of the reason, all of these students struggled when it came to Accountable Talk.

Why Students Struggle with Accountable Talk[®]

Students struggle with Accountable Talk[®] for many reasons. This strategy hinders student learning of mathematics and it has negative social implications.

Accountable Talk[®] strategies might get in the way of helping students to understand the mathematics for the following reasons: confusion within the group, difficulty understanding group member solutions, more focused on helping others, and fear of getting wrong answers. According to student 2, "I get really confused when I hear other people's explanations. I get confused very easily. I would rather have the teacher explain it to me." Student 3 adds, "I have a lot of difficulty trying to understand others' methods

in learning how to do stuff. I don't like asking questions." Student 8 felt similarly when she stated, "If my group members don't understand, and I don't understand, then it's hard to do the work. I am then forced to raise my hand and ask a lot of questions, which I don't like to do." This student really likes school, works very hard, and is afraid of failing. It is interesting that students want to be successful but don't like to ask questions.

Student 15 states,

It just mixes me up a little bit, because I don't really know what they are talking about when they tell me how to do the problem ... I just need somebody to show me how to do it instead of just telling me ... I have a hard time understanding other people's explanations.

Student 15 is very quiet and timid. She has a very difficult time focusing in class, especially when working in groups. This is due to the fact that she has been diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). Student 11 states, "Because if I don't understand the questions and what they mean and like when I ask questions, I feel like people are laughing at me, so I am afraid to ask questions." This student really struggled with the transition into middle school. She really struggled in pre-algebra. So, working in groups didn't help deepen her understanding because her math foundation was very weak, which leads to more confusion, and, eventually, to shutting down. When the class is practicing Accountable Talk® strategies, some students just don't understand the academic language. They are often lost and confused and don't know where to go with it.

Other students expressed that Accountable Talk® strategies got in the way of their own learning, because they were constantly helping other students. Student 5

expresses that Accountable Talk® got in the way “because I am the only person who knows how to do it, and I have to teach the other kids. I do not even know if I am right or teaching them right.” Student 6 states, “I focus more on helping the other people instead of my own work.” Student 6 is very social and a smart student. He does not struggle in pre-algebra and is not afraid to ask questions for clarification. However, when it comes to conversing or explaining his work, he really struggles. While student 7 says “It’s just hard for me to work and talk to a partner at the same time. I just can’t stay on track doing it.” These students are not only concerned about their own learning, but also with the members in the group. There is pressure to want to help others but also to help themselves.

Some students also felt that Accountable Talk® strategies got in the way of learning, because it was very easy to get off task and talk about unrelated material. Student 10 states, “It gets in the way, because it’s easy to get off task and talk about things we are not suppose too.” Student 12 adds, “because like kids get off task and start talking about other stuff rather than math.” Student 12 is easily distracted and finds math uninteresting. She struggles in pre-algebra because she lacks focus. So there are a variety of reasons why students struggle with Accountable Talk® and how it gets in the way of their mathematics education.

When students are asked to talk in groups, there many different thoughts that they are feeling. All of the students in this study had negative thoughts and feelings toward participating in Accountable Talk® activities. These thoughts and feelings can be

contributed to the ways that they struggle. Some of these feelings include: nervousness, discomfort, annoyance, pressure, worry, stress, and anxiety. Student 4 states,

If I am in a group with four people I don't know, I feel anxiety...like social anxiety. What rushes through my mind when I am in a group of strangers is like nervousness ... ummm I'm like, are these people rude? Am I able to talk to these people or are they going to ignore me? Are these people snobby? Are they snotty? All of these things go through my head. It's just really hard for me to speak to them, because of my insecurities and stuff. I do shut down sometimes and don't do anything at all, or I am really silent and not talking at all.

This student is quiet and shy. She struggles in pre-algebra and has a very difficult time communicating and asking question from teachers and peers. This student has difficulty focusing in class and often shuts down. Student 9 adds,

I am really nervous. I don't want to give wrong answers. I am embarrassed, because I don't want to give the wrong answers. I try to work the problems out before I say anything. I don't want to get the wrong answers.

This is very interesting because this student in very attentive in class, does all her home-work, and performs well on tests. Student 15 states, " It just makes me nervous, because I am scared that like everybody is going to think I am dumb for not being good a math. I feel down on myself, because everybody gets it but me." Students 12, 13, and 16 also feel anxious and nervous when they have to work in groups. They find it more challenging to work in groups where they don't know the group members.

Students do not want to feel stupid in front of their peers. According to student 14, "I don't want people to think I am stupid, so I kind of feel self-conscious. I am

like ‘Oh my gosh, I have to talk to other people about stuff that I probably don’t even get.’” Student 8 continues by saying,

I am out of my comfort zone. I will try not to talk. I will stay low so nobody will ask me questions. I don’t want people to make fun of me. I don’t want to feel stupid. I am afraid to make mistakes. It feels like people are watching me, and I am in the spotlight or in the middle. I am uncomfortable and shy.

Student 1 feels worried and stressed, because she doesn’t want to look dumb or get the wrong answers. She adds that she doesn’t like talking about subjects that she doesn’t know very well. While student 2 states, “I feel bad. I am a very shy person. I don’t like talking to random people, and I don’t want to feel stupid in front of people I don’t know. I often shut down when I have to work in groups. I don’t like it.”

Students who were interviewed had feelings of pressure and feeling out of place. These feelings are another factor in why students struggle with Accountable Talk®. Student 6 states,

I feel a lot of pressure. I feel like I am forced to help other people when I already know how to do it. I feel like it is a waste of my time. I just want to do my work and finish it and not help other people. I feel like I don’t want to work in groups. I want to work by myself. I work better alone, and I ask to work by myself.

Student 7 adds, “It makes me feel uncomfortable, because I feel like I am the teacher when someone doesn’t get it. I feel like I have to take it step-by-step and then they’re like, ‘no I don’t get that either.’” Student 3 continues by saying, “I hate working in groups. I get really uncomfortable, and I don’t know what to do.” While student 5 adds,

“It makes me feel annoyed, because I am the only one that knows anything. I feel like I teach them, but they don’t listen to me.”

When asked the question, “Why do students struggle with Accountable Talk[®]?, the students in the study answered this question with openness and honesty. There is a clear picture of why students are struggling and how it is impeding their learning.

Importance of Accountable Talk[®] in the Classroom

Students in this study had some very positive comments about Accountable Talk[®] strategies. The students who displayed negative feelings towards this practice still felt it was important and could work with other students. Student 7 states, “I do think it is important, because it helps other people, but it is just not for me. I can see other people using it.” Student 17 adds, “It is important to do sometimes because if you don’t talk about it, and you don’t know what your suppose [sic] to do, you will get stuck on it and not learn anything.” This student does not struggle with pre-algebra, however, she struggles with talking about math. She does not like to be in groups and would rather work alone. However, the majority of the students felt like this was an important strategy to use in the classroom. Student 1 states, “Yes, I think it’s important, because it gives me time to talk to people about my solution, and I also get to hear their solutions. The more time I get to talk the more I learn.”

Student 8 adds, “Yes, it is important. It helps you understand concepts better and gives you a chance to talk to peers about the subject.” Student 13 continues on by saying, “Yes, I think it is important. It gets people ready for like what the future holds and everything that we have ahead. It helps you talk to people and helps your social skills.”

Accountable Talk[®] in the classroom affects the student’s behavior positively and negatively. Students are held accountable for the knowledge they have learned when Accountable Talk[®] is used in the classroom. Student 1 states, “When I know I have to talk, I pay attention more, engage in the lesson more, and take really good notes.” Student 11 adds, “When it comes to engaging in the lesson, I do better and I pay attention more, because in the end, I know I am going to have to participate in different activities.” Some of the students felt that they already took good notes and were engaged, regardless of Accountable Talk[®] or not. However, Accountable Talk[®] affected some students negatively. Student 16 states, “I just sit there, because I am nervous, and I will not talk. I get lost in my head and blank out. I will forget what they say, and I don’t listen.”

Student 15 adds,

I am just thinking like, “Oh my gosh, I’ve got to get an answer quicker than them. I got to get an answer quicker than anybody else, before, you know, they get their answer. And then, I just kind of get off task and then kind of do the wrong problem in the wrong way, make little mistakes, and work faster than I should.”

Student 7 felt that, “It does affect my behavior. I do not pay attention, get off task and then talk to my partner and get off task ... get yelled at. It makes matters worse.” In

some cases, Accountable Talk® has a positive affect on student's behavior and, in other cases, it does not.

The last question of the interview was "How could the teacher help you with Accountable Talk®?" Most of the students felt like there was nothing the teacher could do to help them. Student 7 felt "a perfect lesson for me would be a teacher teaching the lesson, and then, I get to do it by myself without anybody around me." Some students felt that picking their own groups would help them feel more comfortable when working in groups. A couple of students felt like this was a problem that only they could fix and that the teacher had no control over it.

CHAPTER V

DISCUSSION

Discussion of the Findings

After studying the data, the researcher saw three main groups that students fell into. The first group had three students in it. These three students are all proficient in pre-algebra and got good grades in my class. All of the students in this group generally feel that school is important and tried their hardest in all of their classes. After interviewing all of them, they held the attitude that academic discourse did not help their learning. According to student 5, Accountable Talk[®] doesn't help with her understanding of mathematics, it only hurts it. This student would prefer to talk to the teacher (personal communication, May 31, 2013). Student 7 stated, "I don't really think Accountable Talk[®] helps me at all. When I am talking in groups, it is really hard for me to stay on task and focus on math. Whereas, when I am working alone, it's just math always in my head" (personal communication, May 28, 2013). Similarly, student 6 had a hard time staying focused in groups, and often felt that he focused more on his group members' questions than his own work (personal communication, May 29, 2013). From this, the

researcher inferred that the students in this group did not see any benefits from this strategy.

Students in this first group also noticed when they were talking in groups or pairs, that they were basically re-teaching the concepts to their group members. Student 5 stated, "Accountable Talk[®] gets in the way, because I am the only person who knows how to do it, and I have to teach the other kids in my group. I don't even know if I am doing it right or teaching them right" (personal communication, May 31, 2013). Similarly, student 6 also struggles with the role of being the leader and guiding his group.

It makes me feel uncomfortable, because I feel like I am the teacher when someone doesn't get it. I feel like I have to take it step-by-step and my group members still don't get it. So now, I feel like I can't really help them, because I am not really good at describing how I do it. (personal communication, May 29, 2013)

In the interview with student 7, he describes a similar situation.

I struggle working in pairs ... when I am working in pairs, I feel like I go to stop what I am doing and help someone else. It's a constant back and forth with my work, then helping, my work, then helping. (personal communication, May 28, 2013)

The students in this group recognized that there was never a fluent conversation being held in their group, and that they were doing all of the talking. Oftentimes, these students felt very frustrated, because they weren't even sure if they were communicating the right information. Several times throughout the interviews, the students in this group stated how they would prefer to work alone and how working in groups slowed them down.

Within this group, the students had general feelings of discomfort, pressure, and annoyance. Student 5 stated, "Working in groups makes me feel annoyed, because I am the only one who knows anything...it annoys me, because I teach them, but they don't listen to me" (personal communication, May 31, 2013). According to student 6, "I feel a lot of pressure. I feel like I am forced to help other people when I already know how to do it. I feel like it is a waste of my time. I just want to do my work and finish it and not help other people" (personal communication, May 29, 2013). Student 7 describes similar feelings of discomfort and doubt. After analysis of each interview, the researcher concludes that all of the students in this group lack the confidence to be in a leadership role. The researcher believes that these students understand the mathematical concepts but lack the confidence to communicate what they know.

There were seven students who fell into the second group. Five of these students were proficient and got good grades. Two of the students were not proficient. All of the students in this group really try hard in school and want to do their best. The reason why these students struggled with academic discourse was because of social anxiety. They had a hard time talking to people they did not know. According to student 4:

When I have to participate in groups, I feel anxiety, like social anxiety. What rushes through my mind when I am in a group of strangers is like nervousness. Am I able to talk to these people or are they going to ignore me? I do shut down sometimes, and just don't do anything at all, or I am really silent and not talking at all. I stop listening, and I focus on the fact that I have to talk, which affects how much I learn. (personal communication, May 31, 2013)

According to student 17, "I am nervous, because of the people I don't know. It's harder for me to talk to them, because I don't really know them as much." (personal communication, May 29, 2013) Students within this group have this fear of getting the wrong answer and feeling bad or stupid for not knowing how to do the problem. According to Student 8, "When I am out of my comfort zone, I will try not to talk. I stay low so that nobody will ask me questions. I don't want people to make fun of me. I don't want to feel stupid. I am afraid to make mistakes" (personal communication, May 28, 2013).

Student 9 describes a similar situation:

I am really nervous when I have to work in groups. I don't want to give wrong answers. I am embarrassed because I don't want to get the wrong answers. I try to work the problems out before I say anything, because I don't want to get the wrong answer. (personal communication, May 29, 2013)

Similarly Student 14 stated, "I don't want people to think I am stupid, so I kind of feel self-conscious ... I feel like I have nothing to give to the group, because I don't know it" (personal communication, June 4, 2013). From the interviews, the researcher gathered that the students in this group don't have a lot of confidence in their mathematical abilities. It seems that these students have a fear of social rejection and, in turn, shut down. Some words that they used to describe how they felt about practicing academic discourse were nervous, anxious, worried, scared, bad, uncomfortable, and shy. Student 12 adds, "Sometimes I get nervous and anxious if I don't know the people in my group. It makes it challenging" (personal communication, May 23, 2013)

According to Student 10, "I am really shy, and I don't want to talk to people I don't know. I don't want to get the problem wrong and feel stupid in front of my group. I get really nervous, because I usually don't know the people in my group. I am afraid to talk to them, and I don't want to feel stupid" (personal communication, May 28, 2013)

All of the students within this group lack mathematical confidence. These students are afraid to share their solutions in fear that they might make a mistake. Some of the students in this group shut down and do not even participate in the activity, because they do not want to be wrong and/or are unsure of their solution.

The third group had seven students. Two of the students were approaching proficiency and the other five students were not proficient. These students have a very weak mathematics foundation. All of these students were very hard workers but struggled with mathematical concepts. "Yes, I struggle in pre-algebra. I really don't like working with numbers and solving problems. I get confused really easy, and then don't know what to do after that" (student 3, personal communication, May 26, 2013). Student 1 stated, "I think I struggle, because it just takes me longer to understand the math. I feel like I understand it. Then, when I go to take the test, I forget it all and make little mistakes" (personal communication, May 26, 2013). Student 2 adds, "I get easily confused. I don't understand how to do the problems, and so I just give up. Numbers really confuse me, and I struggle with some of the simplest problems" (personal communication, May 26, 2013). According to Student 13, "I have a hard time setting up problems, and I make a lot of little mistakes. I also work really fast, and it takes me a long time to learn the

concepts" (personal communication, June 4, 2013). Students 11, 15 and 14 had similar descriptions with why and how they struggled in pre-algebra.

The reason why they struggled with academic discourse was because they did not know how to answer the questions and then give an explanation. "I get really confused when I hear other people's explanations. I get confused very easily. I would rather have the teacher explain it to me" (Student 2, personal communication, May 26, 2013). Student 11 adds, "I feel that there is a disconnect between what I think I know and what I actually know. I often feel nervous and frustrated, because they keep explaining it, and I don't understand it" (personal communication, June 4, 2013). According to Student 3, she makes a lot of little mistakes, and she does not realize that she has done it. She also thinks that the class moves too quickly through the concepts and she gets further and further behind. All of these students lacked mathematical confidence. Even if they knew how to answer the question, they did not know how to verbalize it.

Students within this group do not have the ability to get the help they need, because they are so far behind. These students have a very weak foundation in mathematics and are still trying to understand the basics. They didn't want to feel stupid or ask questions in front of their peers. "I feel like if I get something wrong that they understand, they will think I am dumb. I shut down when I know I have to work in groups...I don't want to feel stupid in front of the other kids" (student 2, personal communication, May 26, 2013). According to student 11, "...I don't understand the questions, and what it means, and like, when I ask questions, I feel like people are laughing at me...and it

makes me feel stupid...so I am afraid to ask questions" (personal communication, June 4, 2013). Student 15 adds,

It just makes me nervous, because I am scared that like everybody is going to think I am dumb for not being good at math...I kind of wish that I got math a little better than I usually do. I feel like I am down on myself, because everybody gets it but me (personal communication, June 4, 2013).

When working in groups, they would just wait for the "smarter students" to show them how to do the work. The researcher concluded that the students within this group wanted to participate in the Accountable Talk® activities but could not due to their lack of mathematical knowledge. These students wanted to be a part of the group but were being held behind by their lack of knowledge in the subject matter.

In conclusion, there are many reasons why students struggle with Accountable Talk®. Regardless of the student's academic ability, be it proficient, basic, or below basic, students from all academic abilities struggle with this strategy. All of the students who were interviewed felt that Accountable Talk® strategies were an important tool to use in the classroom.

Conclusion

Accountable Talk® is a teaching practice that was developed by the Institute for Learning at the University of Pittsburgh and is primarily based upon Vygotsky's theoretical framework the "social formation of mind" (Ferryhough, 2008; Imm & Stylianou, 2012; Moll, 1990; Sohmer et al., 2007; Zolkower, & Shreyar, 2007). Accountable Talk® is a type of classroom discourse that promotes learning that is accountable to the

following areas: the learning community, accurate and appropriate knowledge, and rigorous thinking. This teaching strategy was developed in 1995 and is still being used in our education system today.

The purpose of this study was to examine why, and in what ways, students struggle with Accountable Talk® practices. This study shows that students from all academic levels struggled with Accountable Talk® practices. One group of the students struggled because they were uncomfortable with the leadership role that they had to take. They also felt that this strategy did not enhance their learning abilities and sometimes left them feeling confused. A second group of students were not socially mature enough to engage in Accountable Talk® practices. These students were nervous and often shut down when they had to participate in any form of academic discourse. A third group of students lacked the mathematical foundation to effectively participate in Accountable Talk® activities. These students had no mathematical confidence and needed serious remediation. It was really difficult for them to participate in the activities because they truly did not understand the mathematics. To help meet the needs of these students, the teacher could have re-grouped them or let them choose their own groups to help support their success in a group setting. This study also showed that all of the students felt that Accountable Talk® was an important teaching strategy and that it should have a place in the classroom. The researcher thought that it was also important to point out that all of the students interviewed struggled with this strategy but were motivated and still worked hard throughout the year. During the process of analysis of

data and writing this thesis, the researcher had some questions: a) How do you meet the needs of students who are not proficient and still implement Accountable Talk® strategies? b) How do you build student's confidence level in mathematics? and c) How do you show students the benefit from working and communicating together?

Recommendations

Future research is needed to determine why students struggle with academic discourse in a mathematics classroom. The following recommendations are made for future studies.

1. Design a better Likert scale survey. In this study, the Likert scale survey measured three different attitudes: a) attitude towards mathematics, b) motivation of students learning mathematics, and c) attitude towards Accountable Talk®. Each of these attitudes being measured should have had at least 20 questions. Of these 20 questions, half should have been positive statements and the other half should have been negative statements. The Likert scale survey for this study should be 60 or more questions.

2. The researcher believes that the Likert scale survey should be given both at the beginning of the year and at the end. The reasoning behind this is to see if the students' attitudes have changed. The researcher thinks that it could be beneficial to compare and contrast students' attitudes. This may help the researcher gain a deeper understanding of why students do or do not struggle.

3. Design an instrument that measures attitudes and feelings about classroom environment, to be given multiply times throughout the year. The researcher felt that it would be important to know how students are feeling about the environment in the classroom. This instrument would, hopefully, give insight on how the teacher can make a more comfortable environment for all students. It is important this instrument be given multiply times throughout the year, because the environment in classroom can change and teachers need to made aware of these changes.

4. Create activities that encourage academic discourse and are differentiated so that all academic levels can participate. The researcher discovered that some students' math abilities were too low to even participate in Accountable Talk[®] activities. Accountable Talk[®] activities need to be accessible to all students.

5. Repeat the study with a larger sample size. The researcher felt that her sample was much too small and felt the results would have been more fruitful if the sample had been larger. The researcher also felt that sampling from multiple classrooms, with different teachers, might show different results.

6. Create a survey that measures student learning in mathematics. The researcher felt that it would be helpful to know how her students learn.

The researcher is convinced that incorporating Accountable Talk[®] strategies into the pre-algebra curriculum is very important and plans to do so throughout the years.

Limitations

There were several limitations in this study. First, the study was not a random sample. The researcher sampled four of my own pre-algebra classes, which involved 116 students. Since the sample size was small, it would be hard to generalize the findings in this study. Further, the data from this study is coming from the culture and environment of one classroom and one teacher. This presents a problem in generalizing the results. Different teachers' implementation of the same teaching strategy is very different from classroom to classroom.

Second, there were several flaws in the design of the Likert survey. All of the statements written had a positive attitudinal object except for one. It is recommended that Likert surveys should have half positive and half negative statements. It is also recommended that Likert surveys should have 20 or more questions per attitude that are tested. The researcher was testing three attitudes, and the survey was only 14 questions long. The researcher felt that the survey should have been longer and more specific. Each of the subsets of the survey should have had more questions. The researcher would also have changed the scale from "not sure" to "neutral." The researcher felt that the students who chose "not sure" could have been confused by what the researcher meant. Some students could have picked this because they didn't want to answer the question, which might have flawed the scores and the results of the survey.

Another flaw in the design of the Likert survey was discovered after looking at the Cronbach's Alpha. The Cronbach's Alpha value for questions 1, 3, 4, and 7 was

0.61. This means that these questions have a less constructed scale and these questions need to be reworded or removed from the survey. Similarly, Cronbach's Alpha value for questions 2, 5, 6, and 8 was 0.63, meaning some change is needed to be made in these questions. The researcher felt that question 2 should have been dropped completely from the survey. Question 3 should also have been dropped from the survey or moved to the third subset of the survey. After further review, the researcher felt that some of the questions were not measuring the attitude that the researcher was trying to measure. For instance, question 1 was measuring attitude towards mathematics and the argument could be made that one could hate mathematics, but could also feel that it takes a special talent to do well in mathematics. The researcher also felt that more questions should have been added to the sections.

REFERENCES

REFERENCES

- Accountable Talk. (2013). Retrieved from Retrieved from <http://www.msvl.k12.wa.us/staff>
- Achieve, Inc. (2013). Americans need advanced math to stay globally competitive. Retrieved from <http://www.futurereadyproject.org/sites/frp/files/MathWorks-GloballyCompetitive.pdf>
- Bennett, C. (2010). "Its hard getting kids to talk about math": Helping new teachers improve mathematical discourse. *Action in teacher education*, 32(3), 79-89.
- California Department of Education. (1999). Mathematics content standards for California public schools: Kindergarten through grade twelve. Retrieved from <http://www.cde.ca.gov/be/st/ss/documents/mathstandards.pdf>
- Casner-Lotto, J., & Barrington, L. (2006). *Are they really ready to work? Employers' perspectives on the basic knowledge and applied skills of new entrants to the 21st century U.S. workforce*. Partnership for 21st century Skills, 1 Massachusetts Avenue NW Suite 700, Washington, DC.
- Cirillo, M. (2013). What does research say the benefits of discussion in mathematics are? Retrieved from <http://www.nctm.org/news/content.aspx?id=35384>
- Cook, L. B. (1998). Encouraging "math talk" in the classroom. *Middle School Journal*, 29(5), 35-40.
- Fernyhough, C. (2008). Getting Vygotskian about theory of mind: Mediation, dialogue, and the development of social understanding. *Developmental Review*, 28(2), 225-262.
- Huberman, A., & Miles, M. (1983). Drawing valid meaning from qualitative data: Some techniques of data reduction and display. *Quality & Quantity*, 17(4), 281-339.
- Imm, K., & Stylianou, D. A. (2012). Talking mathematically: An analysis of discourse communities. *The Journal of Mathematical Behavior*, 31(1), 130-148.

- Institute for Learning. (2013). History and principals of learning. Retrieved from <http://ifl.lrdc.pitt.edu>
- Jeroski, S., Booth, L., & Dockendorf, M. (1992). *Field-based research: A working guide*. Victoria, British Columbia, Canada: Ministry of Education and Ministry responsible for Multiculturalism and Human Rights.
- Michaels, S., O'Connor, C., & Resnick, L. B. (2007). Deliberative discourse idealized and realized: Accountable talk in the classroom and in civic life. *Studies in Philosophy and Education*, 27(4), 283-297.
- Michaels, S., O'Connor, M. C., Williams Hall, M., & Resnick, L. B. (2010). *Accountable Talk sourcebook: For classroom conversation that works*. Pittsburg, PA: University of Pittsburgh.
- Middleton, J. A., & Jansen, A. (2011). *Motivation matters and interest counts*. Reston, VA: National Council of Teachers of Mathematics.
- Mills, G. E. (2011). *Action research: A guide for the teacher researcher*. Boston: Pearson Education.
- Moll, L. C. (1990). *Vygotsky and education: Instructional implications and applications of socio-historical psychology*. Cambridge: Cambridge University Press.
- Moyer, P. (2000). Communication mathematically: Children's literature as a natural connection. *Reading Teacher*, 54, 246-255.
- National Assessment of Education Progress. (2009). Retrieved from http://ifl.pitt.edu/nationsreportcard.gov/math_2009/summ.asp
- National Center for Education Statistics. (2011). Trends in international mathematics and science study. Retrieved <http://nces.ed.gov/Timss/index.asp>
- National Council of Teachers of Mathematics. (2000). Principles and standards for school mathematics. Retrieved from <http://www.nctm.org/standards/default.aspx?id=58>
- Nunnally, J. (1978). *Psychometric theory*. New York: McGraw-Hill.

- Peterson, P. E., Woessmann, L., Hanushek, E. A., & Lastra-Anadon, C. X. (2011). *Globally challenged: Are U.S. students ready to compete? The latest on each state's international standing in math and reading* (Report PEPG 11-03). Cambridge: Harvard University, Program On Education Policy And Governance.
- Petrilli, M. J., Scull, J., Thomas B., & Fordham, I. (2011). *American achievement in international perspective*. Washington, DC: Thomas B. Fordham Institute.
- Piccolo, D. L., Harbaugh, A.P., Carter, T. A., Capraro, M. M., & Capraro, R. M. (2008). Quality of instruction: Examining discourse in middle school mathematics instruction. *Journal of Advance Academics*, 19(3), 376-410.
- Quinn, R. J., & Wilson, M. M. (1997). Writing in the mathematics classroom: Teacher beliefs and practices. *The Clearing House*, 71(1), 14-20.
- Resnick, L. B. (1999). Making America smarter. *Education Week Century Series*, 18(40), 38-40.
- Rotherham, A. J., & Willingham, D. (2009). To work, the 21st century skills movement will require keen attention to curriculum, teacher quality, and assessment. *Educational leadership*, 9, 15-20.
- Sagor, R. (1992). *How to conduct collaborative action research*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Singh, K., Granville, M., & Dika, S. (2002). Mathematics and science achievement: Effects of motivation, interest, and academic engagement. *Journal of Education Research*, 95(6), 323-332.
- Smith, L., Dockrell, J., & Tomlinson, P. (1997). *Piaget, Vygotsky and beyond: Future issues for developmental psychology and education*. New York: Routledge.
- Sohmer, R., Michaels, S., O'Connor, M. C., & Resnick, L. (2003). Guided construction of knowledge in the classroom: Teacher, talk, task, and tools. Retrieved from <http://www.parentseducationnetwork.org/resources/documents/How EffectiveTalk.pdf>
- Thompson, A., & Thompson, P. W. (1996). Talking conceptually about rates: Mathematical knowledge for teaching. *Journal for Research in Mathematics Education*, 27, 2-24.

- Van Zoest, L. R., Stockero, S. L., & Kratky, J. L. (2010). Beginning mathematics teachers' purpose for making student thinking public. *Research in Mathematics Education, 12*(1), 37-52.
- Wolf, M. K., Crosson, A. C., & Resnick, L. B. (2006). *Accountable Talk in reading comprehension Instruction* (CSE Technical Report 670). Pittsburgh: University of Pittsburgh.
- Zolkower, B., & Shreyar, S. (2007). A teachers' mediation of a thinking-aloud discussion in a 6th grade mathematics classroom. *Educational Studies in Mathematics, 65*(2), 177-202.

APPENDIX A

SURVEY

Name: _____ Date: _____ Period: _____

Directions: Please circle the word that represents how you about each statement.

1. I think it takes a special talent to do well in math class.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

2. In math class I like the teacher to teach, discuss and assign only things that I will later be tested on.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

3. I like to talk to my parents and other family members about topics we are currently discussing in math class.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

4. When I think about all the classes I have taken in middle school, math was one of my favorite subjects.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

5. One thing I like about math class is that it is just about working with number and solving problems.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

6. In math class I like work that is challenging so that I can learn new things.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

7. Math is one of my favorite subjects.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

8. In math class, even when new concepts are dull and uninteresting I keep working until I understand it.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

9. I like math more when I am given an opportunity to discuss it with my fellow peers.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

10. I understand the concepts better (or more in depth), when given time to talk to my peers.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

11. The strategy, Turn and Talk, helps me understand concepts more deeply.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

12. I have a hard time communicating with my peers, about mathematics.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

13. I really enjoy working in groups.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

14. I remember more things about the lesson, when I get to talk about it.

Strongly Agree Agree Disagree Strongly Disagree Not Sure

Fill in the blank with your feelings.

15. When asked to work in groups, I feel _____ (Worried, Anxiety, Good, Nervous...)

16. One of the things I find challenging about talking in pairs is (if it is not challenging explain why it is not.)

18. To make me feel more comfortable in class the teacher could do _____

APPENDIX B

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Dear Parent/Guardian,

I am involved in a research study for my Master's Thesis, in the Department of Mathematics, at California State University Chico. The study I am exploring involves students experiences with the teaching strategy academic discourse and the struggles they have. By signing this consent statement you agree that your child can be involved in this research study and your child's participation in the study is voluntary.

Your child's participation in this study is to answer questions related to their experience with the teaching strategy academic discourse. There will be an interview session that will be audio recorded at school during school hours. The audiotapes will be used solely by the researcher, secured in a safe place until the project is complete, and destroyed upon completion of the research.

There will be no risks or benefits to be experienced by your child's participation. Choosing not to participate will not affect your child's grade in any class. Your child can stop their participation in the at any time. Your child's confidentiality will be maintained to the fullest extent. Personal names will not be used and subjects will be identified in the research by the title (student 1, student 2, ect.).

Please call me at the number below if you have any questions.

If you agree to allow you child to participate, please sign below.

Parent/Guardian Printed Name

Parent/Guardian Signature

Date

Student Name Printed

Student Signature

Date

Thank You,

Beth Dittman

APPENDIX C

INTERVIEW QUESTIONS

Name: _____ Date: _____ Time: _____

In this interview I will ask you about your experiences about Accountable Talk as a student in a mathematics class. The purpose is to get your perceptions of your experiences inside the classroom. There are no right or wrong or desirable or undesirable answers. I would like you to feel comfortable with saying what you really think and how you really feel.

1. What is your educational background? Name, Grade... What are your general feelings towards school?
2. Do you struggle in Pre-Algebra? If yes, explain why.
3. Why do you think you struggle in Pre-Algebra? In what ways do you struggle?
4. When we use Accountable talk strategies in class, can you explain the ways in which it helps you to understand the mathematics?
5. When we use Accountable Talk Strategies in class, can you explain the ways in which they might get in the way of helping you to understand the mathematics?
6. When asked to “talk academically” in small groups, what goes on in your mind? Can you describe that?
7. Do you think Accountable Talk Strategies help you understand mathematics? Explain why or why not.
8. When asked to “talk academically” in small groups, how does that make you feel?
9. Do you struggle “talking” in other subject matters? If yes, what subjects? And explain why?
10. Do you think “talking academically” is important in classroom? Explain why or why not?

11. When you know that you have to “talk academically” in a class, what’s going on in your head? Does it affect any decisions that you make?

- Do you pay attention more or not?
- Are you more engaged in the lessons? Yes/No
- Do you take better notes? the same? Or worse?
- Are you better prepared? Or not?

13. How could the teacher help you with “academic talk”?

14. Do you have any final thoughts or comments regarding Accountable Talk?