The Effects Of Discourse And Journal Writing On Students' Attitudes Towards Mathematics In A Fifth Grade Classroom: An Action Research Study

2005

Anna Rose
University of Central Florida

THE EFFECTS OF DISCOURSE AND JOURNAL WRITING ON STUDENTS' ATTITUDES TOWARDS MATHEMATICS IN A FIFTH GRADE CLASSROOM: AN ACTION RESEARCH STUDY

by

ANNA K. ROSE
B.A. University of West Florida, 1987

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

Fall Term
2005

ABSTRACT

The purpose of this study was to investigate how my use of discourse and journal writing affected students' attitudes and conceptions of mathematics in a 5th grade mathematics classroom. The nature of students' strengths and weaknesses with mathematics using discourse and journal writing were described.

To show students' attitudes towards the two teaching methods transcription of teacher and student discourse on digital audio recordings, observational notes, journal writing, and pre and post attitude surveys were used. The research approach was qualitative and quantitative. The participants in this twelve-week study were twenty fifth grade students from a private school in central Florida.

Through analysis of the data collected, the students showed positive improvement in attitude towards discourse and journal writing in the mathematics classroom. The study supported that discourse and journal writing are important to student learning.

For Bill, Marissa, and Ally

ACKNOWLEDGMENTS

I would like to give my heartfelt thanks to everyone at the Lockheed-Martin Academy for their help and guidance throughout these two years. I would like to thank the staff, parents and especially the 5th grade students from my private school for their understanding and support. Also, my cohorts in this program have become friends. Thank you for all of your help. Most of all, I would like to thank my family for their love and help throughout these two years and especially this thesis.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

Introduction

Research shows that discourse and journal writing enhance students' understanding in mathematics (Alro & Skovsmose, 2002; Bickmore-Brand, 1990; Curcio & Artzt, 2003; Lampert & Blunk, 1998; Miller, 1992; Murray, 2004; Reeves, 1990; Rittenhouse, 1998; Siegel & Fonzi 1998; Sipka, 1982; Sterrett, 1982; Talman, 1982). Discussion and writing activities provide a window to students' understandings, thought processes, and attitudes about mathematical concepts and mathematics (Murray, 2004; Reeves, 1990; Zucker & Esty, 1993). Siegel and Fonzi (1998) concluded that teachers are provided with insight into students' strengths and weaknesses through writing activities used in the classroom. In his research, Sipka (1982) demonstrated different types of writing assignments that a teacher can use to enhance the learning of mathematics.

The use of discourse and journal writing in the mathematics classroom can effect students' attitudes towards mathematics (Goh & Fraser, 1995; Jurdak & Abu Zein, 1998; NCTM, 2000; Ring, Pape, & Tittle, 2000; Spinner & Fraser, 2002; Zucker & Esty, 1993). Jurdak and Abu Zein (1998) in their study on the effects of journal writing on achievement in attitudes toward mathematics found the journal writing was an "enjoyable

activity for students and a vehicle for learning self-expression. It was also enjoyable to the teacher, for whom journal writing provided a window to how the students thought and felt" (p. 418). In their research, Goh and Fraser (1995) concluded that better student attitudes were found in classes showing more cohesion and less friction. The classroom environment created by the teacher is an important part of student attitudes towards mathematics (Ring, Pape, & Tittle, 2000).

Purpose of the Study

The purpose of this study was to analyze students' attitudes towards discourse and journal writing in a fifth grade constructivist mathematics classroom. Constructivism for mathematics, according to Jaworski (1993), states "that if there is some independent, pre-existing body of mathematical knowledge we cannot know it except through our own experience, and we can only know what we ourselves have constructed, and modified according to further experience" (p. 2). According to Smith, diSessa, and Roschelle (1993/1994) the research shows that the constructivist view of learning in mathematics is taking students' conceptions and using them to "play productive roles in the acquisition of expertise" (p. 115).

In this study, students' conceptions were found by using discourse and journal writing to analyze error patterns that were common with students when completing multiplication, and division problems. Discourse was a method of teaching used in the classroom. Students were given time to verbalize how they completed a certain

mathematical problem when they answered correctly or incorrectly.

Journal writing was another method of teaching used in the classroom where students wrote about how they solved a particular mathematical problem. Based on my experience, journal writing helps the teacher examine the error patterns of the students and understand how the student 'sees' the mathematical problem. The teacher can then write to the student about the approach used to solve a particular mathematical problem.

I examined students' attitudes towards the two teaching methods by using transcription of teacher and student discourse on digital audio recordings, observational notes, and by giving the students pre and post attitude surveys. I also examined the students' attitudes towards mathematics using the same data collection methods. I wanted to find students' mathematical conceptions by using discourse and journal writing in the classroom.

At the beginning of the research, the students took two attitude surveys that determined their attitudes towards discourse, journal writing, and mathematics in a fifth grade classroom. Students' attitudes towards mathematics were assessed by using the Modified Fennema-Sherman Mathematics Attitudes Scale (1976) (see Appendix A). The Robustness Semantic Differential (Licata & Willower, 1978) (see Appendix B) was used as a pretest that determined if students had a positive attitude towards discourse and/or journal writing in the mathematics class. At the end of the research, the same two attitude surveys were used as a posttest that determined if the two teaching methods had affected students' attitudes toward mathematics.

To investigate the effectiveness of journal writing and discourse in the

mathematics classroom, I used qualitative and quantitative research methods which included the use of transcripts of teacher and student discourse from the digital audio recordings and journal writing in the classroom to determine students' strengths and weaknesses with mathematical concepts. The concepts of multiplication and division were discussed and written about in the student's journal in the mathematics class period. As Driver and Easley (1978) suggest for effective instruction we should search for trends and developments.

Research shows discourse in the mathematics classroom enhances students' understanding in mathematics (Alro & Skovsmose, 2002; Bickmore-Brand, 1990; Lampert & Blunk, 1998; Murray, 2004; Reeves, 1990). Mathematical conceptions can be detected when students express in their own words how they completed a problem. By using discourse in the classroom about mathematics and using appropriate vocabulary, students can express what their approach is to a problem. According to Reeves (1990), "Teacher talk and children talk make mathematics in the mind of the learner" (p. 99). That is to say language has a connection to the mathematics learner. The NCTM's (2000) *Principles and Standards for School Mathematics* state that students in grades 3-5 need to explain the solution for a problem instead of just finding the answer. The Grade Level Expectations for the Florida Sunshine State Standards for Fifth Grade Mathematics (2004) use the language that students need to express, explain, predict, and interpret as a few examples for ways of using the teaching method of discourse in the mathematics classroom. The use of discussion and questioning in the classroom is useful for eliciting students' explanations that reveal what and how they think about a problem (Curcio &

Artzt, 2003). Students need to be encouraged to participate in discussions explaining their ideas and their classmate's ideas in their own words (Stephan & Whitenack, 2003).

Research also shows journal writing activities in the mathematics classroom enhances students' understanding of mathematics (Bickmore-Brand, 1990; MacGregor, 1990; Miller, 1992; Murray, 2004; Rittenhouse, 1998; Sipka, 1982; Sterrett, 1982; Talman, 1982). The NCTM's (2000) *Principles and Standards for School Mathematics* encourages students to think through and explain their solutions instead of seeking or trying to recollect the "right" answer or method. By writing the explanation in a journal the student can take another step toward knowing. Journal writing adds a new dimension in the mathematics classroom by allowing the teacher to respond to students' writings and continue dialogue with the students. According to Miller (1992), for students who are reluctant or unable to respond to a mathematical question in the classroom, the journal writing allowed students time to organize and to express their thought processes in writing privately. Talman (1990) supports the philosophy that students need to write about mathematical concepts so they can construct understanding, because students cannot write coherently about something they do not understand.

A combination of the research and my desire to improve my teaching led me to delve deeper into the effectiveness of discourse and journal writing on students' attitudes. In my 11 years of teaching elementary school, I have observed poor student attitudes in the mathematics classroom. These two teaching methods, I believe, can address students' attitudes towards mathematics. The following questions were researched about students' attitudes towards the two teaching methods, discourse and journal writing, in the

elementary mathematics classroom.

Research Question #1

What are students' attitudes towards the use of discourse in the elementary mathematics classroom?

Research Question #2

What are students' attitudes towards journal writing in the elementary mathematics classroom?

Definitions

The following are vocabulary used throughout the study and their definitions.

- Robustness: a description to show the environmental strength of the teaching practices and teacher involvement on supporting one adjective or the antonym adjective. Bipolar adjectives were used and students would feel more strongly about one adjective or the other.
- Discourse: the verbal interchange of ideas between teacher/student and student/student in the mathematics classroom.
- Journal writing: the writing of students' responses in their journals that expressed

ideas and gave examples about the mathematical concept.

- Conceptions: were students' thoughts or ideas about mathematics.
- Attitude: was a student's mental condition or feeling towards discourse, journal writing, mathematics, and the mathematics teacher.
- Constructivism: was "that children acquire logico-mathematical knowledge by constructing (making) it from the inside, in interaction with the environment" (Kamii & Lewis, 1993, p. 36).

Assumptions

This study was approached with the assumption that by including journal writing and discourse into the mathematics' classroom, students' attitudes toward mathematics would improve. This assumption was based on a thorough review of the related literature and professional experience. It was also assumed that students would do their best on the performance tasks and written responses. My bias towards discourse and journal writing would not influence the data results.

Limitations

There were limitations to this study. One limitation was the type of students involved in the study. The population of students was twenty fifth grade students at a private school in Central Florida. Another limitation of this study was student consistent and sustained participation in every journal writing activity used in the study. There were

student absences, incomplete assignments, and students out of the classroom during class time for unexpected reasons. Students' attitudes toward me, the researcher and the fifth grade mathematics teacher, was also considered a potential limitation of the study.

Delimitations

This study had a couple of delimitations. I used twenty out of the sixty students in fifth grade from a private school in Central Florida that was 79.9% Caucasian. The school was accredited with the Florida Council of Independent Schools, FCIS. The students were from predominately middle to upper income families.

Summary

Students' attitudes towards discourse and journal writing in the mathematics classroom and students' attitudes towards mathematics and the mathematics teacher were further discussed. In Chapter 2, a review of the literature on the theory of constructivism and on the teaching methods of discourse and journal writing were presented. Also, students' attitudes towards mathematics and the mathematics teacher were also reviewed. Chapter 3 discussed the methodology used during the research. Chapter 4 showed the findings and a complete summary of those findings were presented in Chapter 5.

CHAPTER TWO: LITERATURE REVIEW

There is a plethora of research that suggests that the use of discourse and journal writing are effective ways to teach mathematics (Alro & Skovsmose, 2002; Ashlock, 2002; Bickmore-Brand, 1990; Gonzales, 1998; Lampert & Blunk, 1998; Murray, 2004; Talman, 1982). This literature review will show the research on student mathematical conceptions with error patterns and students attitudes towards mathematics with the use of discourse and journal writing in the classroom. Also, a discussion of mathematics within the constructivist classroom is presented. The constructivist classroom uses discourse and journal writing to help students construct understanding of mathematical concepts.

Constructivism

Constructivism according to Kamii and Lewis (1993) states, "that children acquire logico-mathematical knowledge by constructing (making) it from the inside, in interaction with the environment" (p. 36). This definition is based on the theory of Jean Piaget (Kamii and Lewis, 1993). The learning of mathematics in the constructivist classroom, according to Jaworski (1993), states, "that if there is some independent, pre-existing body of mathematical knowledge we cannot know it except through our own

experience, and we can only know what we ourselves have constructed, and modified according to further experience" (p. 2). Constructivism, according to Lorsbach and Tobin (1997), states that "knowledge resides in individuals; that knowledge cannot be transferred intact from the head of a teacher to the heads of students. The student tries to make sense of what is taught by trying to fit it with his/her experience" (p.2). According to Phillips (1995), in the early 20th century Dewey stressed the social nature of knowledge construction. Dewey (1916) refers to students' having knowledge of mathematical conceptions only when they see the problems in which they function and their specific utility in dealing with these problems. Recent trends in philosophy have led to approaches that continue and expand on the themes of Dewey's work on constructivism (Field, 2001).

The constructivist recognizes the possibility of constructing the world in many different ways with their environment (Chrenka, 2001), and considers learning to be an ongoing state. Driver and Easley (1978) argue that "Pupils have to comprehend the new theory; and integrate previous experience into it" (p. 80). Caine and Caine (2002) stated that educators need to engage students' whole body and mind in the classroom so that their natural learning capacities become fully engaged in the subject. Chrenka (2001) states, "Constructivism suggests that teachers need to help students become active inquirers who, when they fail to find the meaning they seek, do not give up hope, but conclude that they have not looked in the right places" (p. 695). Students need to experience a wide variety of math problems with standard examples and nonstandard examples from the real world.

Discourse in Mathematics

The teaching method of discourse in the mathematics classroom is a tool for the classroom teacher to use to analyze students' mathematical conceptions and improve the students' attitude toward mathematics. Discourse in the mathematics classroom can be between teacher and student or student and student. Using this method can help the teacher to analyze students' mathematical conceptions.

The use of discourse in the classroom as shown by research (Alro & Skovsmose, 2002; Gonzales, 1998; Lampert & Blunk, 1998; Murray, 2004; Reeves, 1990) is an important teaching method teachers can use in the mathematics classroom. When the student is given a chance to express thoughts on a subject, that student has a second chance to understand the mathematics concept and correct the prior conception through discourse. Just as Piaget (1964) suggested, students do not need to just identify the shape of an object but the student should manipulate them and use language to justify reasoning. Language and the use of discourse are important in the mathematics classroom. The Grade Level Expectations for the Florida Sunshine State Standards for Fifth Grade Mathematics (2004) state that students need to express, explain, predict, and interpret as a few examples for ways of using the teaching method of discourse in the mathematics classroom.

Other researchers (Bratina & Lipkin, 2003; Vace, 1994; Wickett, 2000) stated that it is important for children to communicate mathematically in the classroom by restating the problem, by expressing their ideas, or by explaining a drawing. This is an example of

the student using discourse in the classroom. Another researcher, Gonzales (1998), wrote about using discourse in the classroom to help children with problem posing. The use of discussion and questioning in the classroom according to Curcio and Artzt (2003) is useful for eliciting students' explanations that reveal what and how they think about a problem. Students need to be encouraged to participate in discussions explaining their ideas and their classmate's ideas in their own words according to Stephan and Whitenack (2003). It is important that elementary school teachers help students begin to develop and refine their communication skills because discourse is an effective way for children to clarify their thinking, discuss new possibilities, extend the thinking of others, and rehearse their ideas for writing as suggested by Whitin and Whitin (2002). Rittenhouse (1998) contends that students need to "talk about the talk." Also, the kind of talk a teacher uses with their students can help students both acquire and learn mathematical discourse. Driver and Easley (1978) suggest that valuable information could be gained by the teacher "through interviewing pupils in order to understand their ideas and ways of thinking about a topic in question" (p. 79).

Discourse is shown as a good teaching method to help in all areas of teaching and learning. Students' low math attitudes come from the lack of confidence or lack of knowledge when working with mathematics concepts. One of the characteristics of a strong mathematics learner is the use of correct terminology (Murray, 2004). The use of correct vocabulary empowers the student to feel confident about what the student is doing. Alro & Skovsmose (2002) state, "We find that if learning is to support the development of citizenship then dialogue must play a basic role in the classroom" (p.

135).

Journal Writing in Mathematics

The teaching method of journal writing in the mathematics classroom is a tool for the classroom teacher to use to analyze students' mathematical conceptions and improve the students' attitude toward mathematics. Through their constructivist approach to teaching, Kamii and Lewis (1993) point out that in a program at Hall Kent School a teacher used writing in the mathematics classroom to keep students from using algorithms. Journal writing can be shared with the teacher or with other students. Using this method can help the teacher to analyze students' mathematical conceptions.

Journal writing according to Pengelly (1990) is a "feature of the language curriculum which is becoming incorporated into mathematics lessons" (p. 13). In his research, Sipka (1982) demonstrates different types of writing assignments and reasons why they can be used to enhance the learning of mathematics. Sipka (1982) mentions journal writing "is a collection of mathematical writings ranging from unfocused diary-like entries to focused entries such as summaries of lectures and discussions of problems" (p. 12). He went on to state that journal writing is probably the most widely recommended informal writing assignment (Sipka, 1982). "Good writing is a reflection of clear thinking, and clear thinking rather than memorization is the key to success in mathematics" according to Henriksen (1982, p. 51). Murray (2004) states that "Mathematical reflections are a multipurpose tool for learning and using technical terms

and building and understanding essential mathematics" (p. 103). Mathematical reflections can be journal entries reflecting on the mathematical concept of the day.

The use of journal writing as shown by research (Alro & Skovsmose, 2002; Ashlock, 2002; Gonzales, 1998; Henriksen, 1982; Lampert & Blunk, 1998; MacGregor, 1990; Murray, 2004; Pengelly, 1990; Sipka, 1982; Talman, 1982) is an important teaching method to be used by the teacher in the mathematics classroom. Journal writing is "an effective channel of communication between student and instructor" (Talman, 1982, p. ix). Not only does journal writing help the student to put their thoughts down on paper but it can be used as a tool to help the classroom teacher discover students' mathematical conceptions. MacGregor (1990) states, "Writing tasks in mathematics are valuable for both teacher and learner" (p. 103). The use of journal writing in the classroom can be used as an informal measure to discreetly assess students' progress with mathematical conceptions without affecting the students' self-conscious feeling.

There are many benefits to students using journals to write in the mathematics classroom. The NCTM contends that, "Reflection and communication are intertwined processes in mathematics learning. Writing in math class can help students consolidate their thinking because it requires them to reflect on their work and clarify their thoughts about the ideas developed in the lesson" (NCTM, 2000, p. 61). Integrating meaningful writing experiences into the mathematics classroom is a fundamental element for developing effective mathematical communication skills, and evaluation of student understanding. In a study of approximately 500 students, Clarke, Waywood, and Stephens (1993) reported that through journal keeping activities, students described what

they had learned, summarized key topics, and identified appropriate examples and questions. Through the process of journal writing students were able to increasingly interpret mathematics on more personal terms, while constructing meaning and connections (Clark et al, 1993). In a study designed to identify the functions that reading, writing, and talking can serve in mathematical inquiries Siegel and Fonzi (1998) concluded that providing students with the opportunity to write about what they have learned allowed both the teacher and student to construct an interpretation of mathematical experiences. Siegel and Fonzi (1998) also contend that collaborative reading, writing, and talking experiences provided opportunities for students and teachers to reflect on and to celebrate student learning. Allowing students to present their mathematical inquiries provided the learning community with an opportunity to place value on student learning and share their experience as mathematical inquirers (Siegel et al, 1998).

There are many benefits to the teacher who uses journal writing in the mathematics classroom. Regular monitoring of journals helped to inform teachers about student progress, coherent, extended and meaningful interactions, engaged students and helped them to make connections between mathematics concepts and the language embedded in their everyday cultural practices (Cicero, De La Cruz & Fuson, 1999). Writing activities have also provided important information about the concepts students understand, and such insights allowed teachers to give proper instructions and explanations in order to clarify conceptions (Pugalee, 1997). In a study to determine teachers' beliefs and practices regarding the integration of writing in mathematics, Quinn

and Wilson (1997) reported teachers at all levels considered writing in mathematics to be extremely beneficial; however, teachers used writing in their classrooms less than once a week. Teachers noted a variety of reasons to rationalize their instructional decisions, ranging from the writing abilities of their students to time impediments. Quinn and Wilson (1997) suggested reflecting on the role of writing in their own learning would allow teachers to recognize the power of writing, making them more apt to use it with their students.

Furthermore, in a study conducted by Jurdak and Abu Zein (1998) with 104 intermediate students whose ages ranged from 11 to 13 years, evidence suggested that journal writing in the mathematics classroom provided cognitive benefits for students in relation to procedural knowledge, conceptual understanding, and mathematical communication skills. In this study, journal writing proved to be rewarding for students, teachers, and even parents who visited the school. Students used journal writing as a tool for learning and self-expression, while teachers used journal writing as an insightful look at how students thought and felt about mathematics.

Students' Attitudes Toward Mathematics

The research support that discourse and journal writing in a constructivist mathematics classroom will have a positive effect on students' attitudes towards mathematics. Spinner and Fraser (2002) essentially stated that providing elementary mathematics students with a constructivist classroom learning environment, promotes

positive attitudes. In a study of the effects of a constructivist-based mathematics problem-solving instructional program on the attitudes, self-confidence, and achievement of post-fifth-grade students, Wade (1994) found from her qualitative data patterns of positive student attitudes towards mathematics.

In a study of volunteer teachers in three counties with 28 pairs of fifth and sixth grade classrooms, Zucker and Esty (1993) promoted the use of discourse in the mathematics classroom. They found that "there is a plausible causal link between changing students' beliefs and improving their problem-solving performance through discourse" (p. 1). Therefore, the improvement of students' attitudes can come through the use of discourse in the mathematics classroom. Also, in the study conducted by Diaz-Obando, Plasencia-Cruz, & Solano-Alvarado (2003) on the impact of students' beliefs and attitudes towards mathematics, they discussed that students' beliefs have a powerful impact on the ways in which students learn and use mathematics in certain contexts. They explained that students, who believe mathematics will be useful to them in the future, develop a desire to learn mathematics. It was stated in Ma's (2003) study that students construct attitudes about certain subjects just as they construct attitudes about other aspects of their world. This process is influenced by environmental factors, such as students, family, and school characteristics, as well as individual influences. Additionally, Ma (2003) explains that research shows that students who excel in mathematics maintain a positive attitude towards mathematics and a motivation to learn mathematics.

Jurdak and Abu Zein (1998) in their study on the effects of journal writing on achievement in and attitudes toward mathematics found the journal writing was an "enjoyable activity for students and a vehicle for learning self-expression. It was also enjoyable to the teacher, for whom journal writing provided a window to how the students thought and felt" (p. 418). Sample (1998) conducted a study to examine the effects of journal writing on students' attitudes. The study consisted of 78 ninth and tenth grade students. The control group consisted of 36 subjects in two intact classes and the experimental, journal writing, group consisted of 42 subjects in two more intact classes. The experimental group was also administered a two part questionnaire to ascertain their perceptions of journal writing in a mathematics class. The journals questionnaire revealed that the experimental group's overall perception of journal writing was rewarding and positive.

The NCTM (2000) guidelines express that the teacher establishes the model for classroom discussion, making clear what counts as a convincing mathematical argument. The teacher also lays the groundwork for students to be respectful listeners, valuing and learning from one another's ideas even when they disagree with them. Goh and Fraser (1995) completed a study of a random sample of 1,512 government elementary students on the learning environment and student outcomes in primary mathematics classrooms in Singapore. They found that, "As the behavior of both teacher and student influence each other mutually, teacher-student interactional behavior is assumed to be of crucial importance to student learning in the classroom" (p. 2). Their research concluded that better student attitudes were found in classes showing more cohesion and less friction

(Goh & Fraser, 1995). In a study on student attitudes, Ring, Pape, and Tittle (2000), concluded that, “attitudes toward mathematics are based on long-term interactions with the subject and mathematics teachers” (p. 1). The classroom environment created by the mathematics teacher is an important part of student attitudes towards mathematics.

Conclusion

In summary, the use of discourse in the classroom gives the students a chance to explain with mathematical vocabulary the process used for a mathematical concept. The use of journals in the mathematics classroom offers an effective approach for the integration of writing into the mathematics curriculum, and provides the teacher and student with a meaningful, authentic avenue for communication. Journal writing has the potential to provide teachers with unique perspectives regarding student assessment and understanding, while in turn providing students with an avenue to communicate and reflect upon their learning.

There is research evidence that supports the use of discourse and journal writing in the classroom to enhance student learning. When students have a chance to restate or rewrite a problem in their words, they take ownership with the work. Research is available to help teachers know what error patterns students may have about a particular mathematical concept. Knowledge of this error pattern can tremendously help the classroom teacher to help students correct those error patterns.

Students’ attitudes towards mathematics, the mathematics’ teacher, and even

towards the teaching methods of discourse and journal writing can have an effect on student productivity. If a student has a poor attitude toward a subject or a teacher, it might be very difficult for that student to work efficiently.

In the next chapter, I discussed the methodology used in the study. I discussed how I used discourse and journal writing in the mathematics classroom and student attitudes towards those two teaching methods. The design of the study was discussed, as well as the methods of data collection and analysis.

CHAPTER THREE: METHODOLOGY

Introduction

The purpose of this study was to examine the students' attitudes towards discourse, journal writing and mathematics in a 5th grade mathematics classroom. The study included twenty 5th grade students that attended a private school in Central Florida 2004-2005 academic year. I was researcher and teacher for this study. This research study documented the use of discourse and journal writing to help students verbalize and write their mathematical conceptions and the effects of students' attitudes towards these two teaching methods.

Design of the Study

This action research study used both qualitative and quantitative research methods. The action research incorporated methods used in Geoffrey E. Mills (2003) book, "*Action Research, A Guide for the Teacher Researcher."* This design was appropriate for teacher researchers who want to reflect on their practices (Mills, 2003). Multiple data collection techniques were included for each research question such as the use of transcriptions of teacher/student discourse from digital audio recordings,

observational notes, attitude surveys, and student mathematical journals. The quantitative approach was used in this action research to find change with students' attitudes towards discourse, journal writing, mathematics, and the mathematics teacher were positive or negative.

The Researcher

This study was conducted at the school where I teach. I have taught the 5th grade level for four years at this school. I am also a parent of two students at the school, and I understand my desire to positively affect the quality of instruction in our school as genuine. I firmly believe that if children have the opportunity to express their thoughts, students can verbalize and write their mathematical concepts and their attitudes can be improved toward mathematics.

My career as an educator began over fourteen years ago. I taught two years at the 2nd grade level and one year at 6th grade level in the Hawaii Public School System. After spending three years at home after my daughter was born, I went back to teaching 2nd grade in a private school in Central Florida. I then accepted my current position teaching 5th grade at another private school in Central Florida. One of my responsibilities for the past two years was teaching mathematics to the entire 5th grade.

Setting and Subjects

The study took place at a private school in Central Florida with students in grades Pre-K to 12th. The school is a coeducational, non-sectarian, independent school, having a strong history of diversity and active learning. The school had a faculty of 35 teachers with a student enrollment of 574 and a similar projection for the following year. The student population was 79.7 percent Caucasian, 4.7 percent Middle Eastern, 4.0 percent Hispanic, 3.8 percent Asian, 3.3 percent Indian, 3.1 percent African American or African, and 1.0 percent Native American. The children were from predominately middle to upper income families.

I used the Scott Foresman – Addison Wesley (2004) 5th Grade Mathematics curriculum to study multiplication and division. I collected data from twenty of my 5th grade students, of which I am the assigned teacher. In the mornings students had Social Studies and all of their specials such as Spanish, Library, PE, and Music in their heterogeneous homeroom groupings. In the afternoons the students had Mathematics, Science, and Language Arts in homogeneous groupings. I met with each class of approximately 20 students in the afternoon everyday for roughly 50 minutes each.

Instruments

For this action research a triangulation of data was used to support conclusions reported on changes in students' attitudes towards discourse, journal writing, and

mathematics. I used five instruments to collect data: observational notes, transcription of teacher and student discourse from digital audio recordings, student journal writings, and two attitude surveys, the Modified Fennema-Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976) in Appendix A and the Robustness Semantic Differential (Licata & Willower, 1978) in Appendix B. I took observational notes in a designated notebook daily on students' mathematical concepts, and/or students' attitudes towards discourse, journal writing, and mathematics. I used a digital audio recorder to get an accurate account of the teacher and student discourse in the classroom. I transcribed those recordings weekly. Student journal writings were also used weekly. Students wrote about multiplication and division, the mathematical concepts covered, with words and examples in their journals.

I used the Fennema-Sherman Mathematics Attitudes Scale (Fennema & Sherman, 1976) to determine changes in students' attitudes towards mathematics. I gave the FSMAS as a pretest and then as a posttest after the research was completed. During the past 20 years, according to Mulhern and Rae (1998), this scale has been used extensively in all types of research on mathematic attitudes. Positively stated items ranked from one for strongly disagree to three for not sure to five for strongly agree. On negatively stated items, the point values were reversed so a high total score on the test would be indicative of a positive attitude. A positive stated question would be - I am sure that I can learn math. A negative stated question would be – I don't think I could do advanced math. Each line item was given a value to determine how the participants answered, whether it was positive, negative, or not sure. After I scored the survey, I placed the data in Excel

and determined a trend with the pretest to the posttest.

I used the attitude survey, Robustness Semantic Differential (Licata & Willower, 1978), as a pretest and a posttest to determine changes in students' attitudes towards discourse, journal writing, and the mathematics teacher. Students responded to this scale which was structured as a semantic differential and included six subscales:

RSD 1 (The mathematics teacher is),

RSD 2 (Journal writing is),

RSD 3 (Mathematics activities are),

RSD 4 (Mathematics activities with journal writing are),

RSD 5 (Discussion in the classroom is), and

RSD 6 (Discussion with mathematics activities is).

A five-point scale with 10 pairs of bipolar adjectives assessing evaluative, activity, and potency dimensions of each subscale were used. Student scores can range from 1 to 5 for a particular subscale. Licata and Willower (1978) identified ten adjective pairs that were used in order to develop and operational definition of the perception of environmental robustness in schools: interesting-boring, challenging-dull, active-passive, unusual-usual, powerful-weak, thrilling-quieting, important-unimportant, fresh-stale, meaningful-meaningless, and action-packed-uneventful. Adjectives which imply robustness that scored a 5 were interesting, challenging, active, unusual, powerful, thrilling, important, fresh, meaningful, and action-packed. Adjectives which imply a lack of robustness that scored a 1 were boring, dull, passive, usual, weak, quieting, unimportant, stale, meaningless, and uneventful. I scored the students' surveys and took the average of each

subscale on the pretest and the average on the posttest and found the difference. Then I divided the difference by the pretest to find the amount of improvement of each subscale over the pretest. I placed the data in Excel to determine changes in students' attitudes towards discourse, journal writing, and the mathematics teacher with the pretest and the posttest.

Procedures

This action research began after receiving approval from my principal. Then I followed the University of Central Florida's Institutional Review Board Protocol (see Appendix C). At the first parent meeting, the parents and/or guardians of my students received a letter (see Appendix D) explaining my action research, how their children would be involved, and to give consent that their child could participate or not participate with the research. After receiving the consent from the parents and/or guardians, I then requested assent (see Appendix E) from my students on the next class meeting. The students volunteered to participate in the research. A video tape and audio tape consent was included on the parent and/or guardian consent form and also on the student assent form. Video tape was not used in this study. The digital audio recorder was kept locked in the filing cabinet in my room when not in use in the classroom.

I began with giving the students the attitude surveys, the Robustness Semantic Differential and the Modified Fennema-Sherman Mathematics Attitudes Scale, as

pretests. I gave the surveys on successive days. Each survey took approximately 20-30 minutes to administer to the students in the mathematics class.

Discourse was used daily in the classroom. A typical class period took 45 to 50 minutes and consisted of reviewing homework and discussing any questions the students had about a problem or mathematical concept covered the day prior. We used the Scott Foresman Addison Wesley 5th grade (2003) mathematics textbook. I started this action research with multiplication and moved through the curriculum to division. I took observational notes daily. The digital audio recording was used during the question and answer period and the recordings were transcribed weekly. Students worked with partners using 'pairs check' in the mathematics classroom. I used this method for students to see immediately if their answer or method was correct. If the problem was correct, the students went to the next problem. If the problem was incorrect, the students went over their process and/or their partner's process and discussed the differences. If a consensus was not reached, the pair raised their hands for help. The digital audio recorder was used during this time also to record student's discourse and thought processes about the mathematical concept. While the students worked in pairs, I walked around the room and wrote observational notes. Daily journal writing was difficult to accomplish in my classroom. Students did not journal daily but they wrote in their journals approximately once a week. Weekly, I transcribed the digital audio recordings, reviewed observational notes, read students journals, and responded to students' writings.

At the conclusion of this action research, I gave the attitude surveys as posttests. The Robustness Semantic Differential was given first and on the following day the

Modified Fennema-Sherman Mathematics Attitudes Scale was administered to the students.

Methods of Data Collection

Data sources included observational notes, students' journals, transcripts of digital audio recordings of teacher/student discourse, and attitude surveys. The data were collected from August 2004 to December 2004. I took observational notes daily. Students wrote in their journals about the mathematics concepts weekly. Not all students participated in all of the journal writing activities for various reasons: absence, taken out of the classroom for various reasons, bathroom break, etc. I looked for typical student attitudes towards mathematics and mathematical concepts to discuss for the next class meeting. Digital audio recordings were transcribed weekly. The Robustness Semantic Differential and the Fennema-Sherman Mathematics Attitudes Surveys were given as pre and post tests on students' attitudes towards journal writing, discourse, mathematics, and the mathematics teacher to determine a trend.

Methods of Data Analysis

Data sources analyzed included observational notes, students' journals, transcripts of digital audio recordings of teacher/student discourse, and attitude surveys. I used my observational notes to find changes in students' attitudes towards discourse, journal writing, and mathematics. My observational notes were also used to record students'

strengths and weakness with multiplication and division. The students' journals were analyzed for students' strengths and weaknesses with multiplication and division and students' attitudes towards discourse, journal writing, and mathematics. I looked for typical student responses. The transcriptions of the digital audio recordings helped me to correctly give student examples and statements that were used in this study. I looked through the transcriptions for typical student responses to multiplication and division problems and student attitudes toward discourse, journal writing, and mathematics. To determine a change in student attitude related to discourse, journal writing, and the mathematics teacher in mathematics classroom, the responses to the Robustness Semantic Differential (Licata & Willower, 1978) were analyzed. To determine a change in students' attitudes towards mathematics, the responses to the Modified Fennema-Sherman Mathematics Attitude Scale (Fennema & Sherman, 1976) were analyzed as stated in the Instruments section of this thesis.

Chapter 4 presented change in students' attitudes towards discourse, journal writing, mathematics, and the mathematics teacher. Triangulation was used to support conclusions reported in this thesis. My observational notes, transcriptions of the discourse from the digital audio recordings and student journals were used to determine students' strengths and weaknesses with multiplication and division as well as their attitudes towards discourse, journal writing, mathematics, and the mathematics teacher. The Modified Fennema-Sherman Mathematics Attitudes Scale demonstrated the change in students' attitudes towards mathematics. The Robustness Semantic Differential demonstrated the change in students' attitudes towards discourse, journal writing, and the

mathematics teacher. I showed how the students' journals were used to show students' strengths and weaknesses, and through the use of discourse, students discussed those strengths and weaknesses in the mathematics classroom. The improvement of students' attitudes towards discourse and journal writing was shown through the use of journal writing, transcriptions of discourse from the digital audio recordings, observational notes, and attitude surveys. After thorough analysis of the data, three themes emerged: the use of discourse and journal writing on students' attitudes towards mathematics in a fifth grade classroom showed a positive effect on students' attitudes, the use of discourse and journal writing showed a positive effect on students' attitudes towards these two teaching methods and the mathematics teacher in a fifth grade mathematics classroom, and through the use of discourse and journal writing in the classroom, students found that they had a lack of knowledge of mathematic ideas.

CHAPTER FOUR: FINDINGS

Introduction

The focus of this action research project was to determine students' attitudes towards discourse and journal writing. From the data collected through the use of observational notes, transcriptions of discourse from the digital audio recordings and students' journal writings, I focused on student conceptions with multiplication, division and equalities. Students' attitudes toward discourse, journal writing, and mathematics were analyzed through the use of observational notes, transcriptions of discourse from the digital audio recordings, students' journal writings, and attitude surveys.

Students' Attitudes Towards Mathematics

Theme 1: The use of discourse and journal writing on students' attitudes towards mathematics in a fifth grade classroom showed a positive effect on students' attitudes. The Modified Fennema-Sherman Mathematics Attitude Scale was used in this action research to analyze students' attitudes towards mathematics. Appendix A gives an example of the Modified Fennema-Sherman Mathematics Attitude Scale. I scored the questions from the pretest and posttest and put the data in Excel to produce a bar graph of

the pre and post averages.

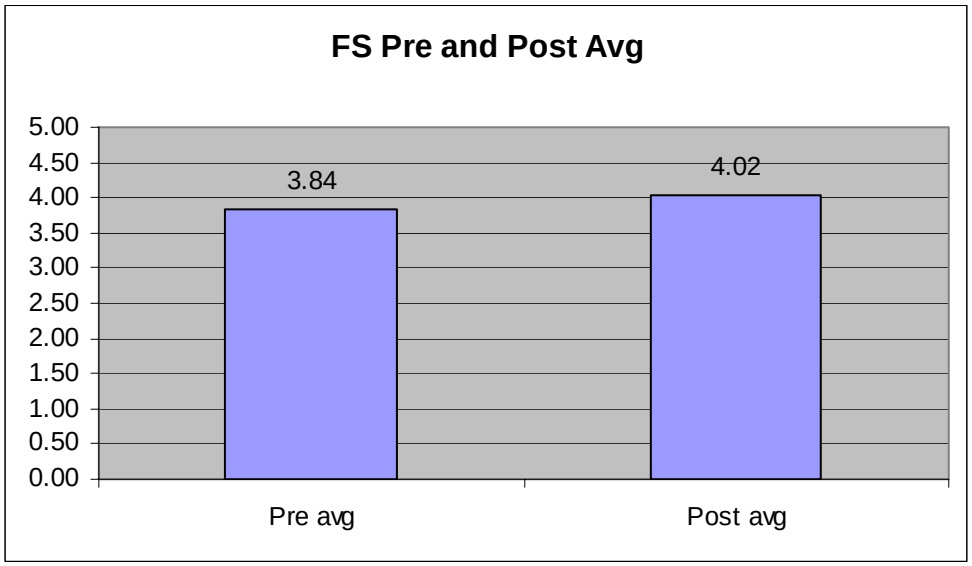


Figure 1 Fennema-Sherman Attitude Scale Concerning Students' Attitudes toward Mathematics

Students' attitudes towards mathematics improved over the time period. The Modified Fennema-Sherman Mathematics Attitudes Scale Survey demonstrated that students' attitudes towards mathematics improved 4.6%. My observational notes and transcriptions of the discourse from the digital audio recordings documented positive attitudes from the students. Typically, students came into the mathematics classroom with smiles on their faces and asking excitedly, "What are we going to do today, Ms. Anna?" Also, when a student finally comprehended a particularly hard mathematical concept, the expression on their face was smiling and they were proud of the work they had accomplished which showed a positive attitude. The research from Goh & Fraser (1995), Jurdak & Abu Zein (1998), Ring, Pape & Tittle (2000), Zucker & Esty (1993), and

Zucker & Fraser (1993) showed that students with positive attitudes towards mathematics were more confident with mathematics.

Students' Attitudes towards Discourse, Journal Writing, and the Mathematics Teacher

Theme 2: The use of discourse and journal writing showed a positive effect on students' attitudes towards these two teaching methods and the mathematics teacher in a fifth grade mathematics classroom. Appendix B shows an example of the Robustness Semantic Differential survey that was used in this study to collect data about students' attitudes towards the mathematics teacher, journal writing, and discourse in the mathematics classroom. After scoring each student's survey, I took the average of the pretest and the average of the posttest and found the difference. Then I divided the difference by the pretest to find the amount of improvement over the pretest. I placed the data in Excel and was able to demonstrate the improvement in a table and a graph. The following Table 1 describes the corresponding RSD level, the sublevel each set of adjectives rated, and the percentage of improvement. Figure 8 shows improvement from the pretest to the posttest in each category over the twelve week study period. I did not include RSD 3, RSD 4, and RSD 6 in my findings since I was not looking at mathematics activities in this study.

Table 1 Robustness Semantic Differential Increase in Positive Attitudes

	Robustness Semantic Differential	Increase
RSD 1	The Mathematics teacher is	8.4%
RSD 2	Journal writing is	13.8%

RSD 5	Discussion in the classroom is	16.1%

This table showed the Robustness Semantic Differential levels 1, 2, and 5. RSD 1 is the mathematics teacher is. RSD 2 is journal writing is. RSD 5 is discussion in the classroom is. For each category the students had to choose between ten sets of bipolar adjectives that best described the mathematics teacher, journal writing, and discussion in the classroom respectively. Table 1 showed the categories to help with the interpretation of Figure 2, the bar graph of the improvement.

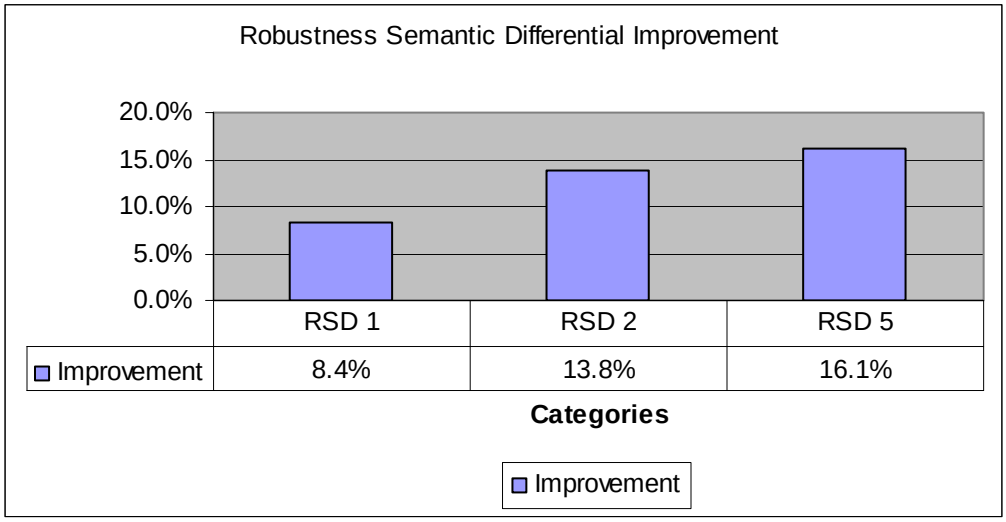


Figure 2 Robustness Semantic Differential Increase in Positive Attitudes

Students' attitudes towards discourse improved over the twelve week period. Data collected over a twelve week period about students' attitudes towards discourse in the classroom, RSD 5, are displayed in Table 1 and Figure 2. Table 1 states the RSD level, the sublevel of students' attitude towards discourse, and the percentage of improvement.

Students' attitudes toward discourse in the mathematics classroom improved by 16.1%. My observational notes also showed that students had positive comments during discourse in the mathematics classroom. The transcriptions of the discourse in the classroom from the digital audio recording showed positive statements from the students such as, "I get it now!" or "I didn't see it that way. I like that way." The students would find new ways of solving a problem from the discourse in the classroom. The research (Goh & Fraser, 1995; Gonzales, 1998; NCTM, 2000) also stated that discourse in the mathematics classroom can promote positive attitudes towards mathematics and is a helpful method of teaching mathematics.

Students' attitudes towards journal writing improved over the research period. Data collected over a twelve week period about students' attitudes towards journal writing, RSD 2, are displayed in Table 1 and Figure 2. According to the Robustness Semantic Differential instrument, the students' attitudes toward journal writing improved over the course of the semester by 13.8%. The students were given the RSD as a pretest at the beginning of the study and then as a posttest at the end of the study. My observational notes showed negative attitudes at the beginning of the study. The transcriptions of the digital audio recordings showed typical statements of, "Aw, man," or "not again." Also, my observational notes showed that the students had positive comments at the end of the study about the journal writing, especially, when we shared ideas that were written in them. Student comments, such as, "I wrote the same thing," were typical as supported by the transcriptions of the discourse from the digital audio recordings and observations of the students smiling. These data sources showed that

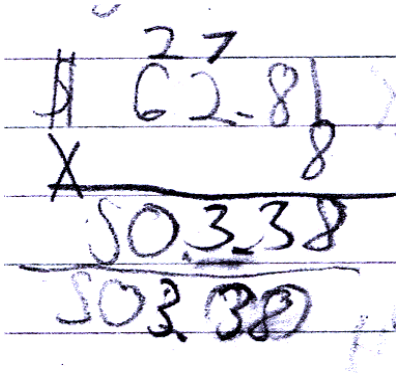
students' had positive attitudes towards journal writing. This analysis goes hand in hand with the research (Alro& Skovsmose, 2002; Gonzales, 1998; Lampert & Blunk, 1998; Murray, 2004; Talman, 1982) that journal writing is an important method teachers can use to promote student learning and positive attitudes.

Students' attitudes toward the mathematics teacher improved 8.4% on the Robustness Semantic Differential insturment. Table 1 and Figure 2 show this improvement from the pretest and posttest given during a twelve week period. My goal was to create an atmosphere where students felt they could ask questions without recrimination from the teacher or the students. The students took the RSD pretest at the beginning of the school year before they knew me and again twelve weeks later. Students' post test results showed that their attitudes towards the mathematics teacher improved. I observed students smiling and interacting positively towards me. If a student did not show a positive attitude, I tried to find out why to help that student to feel better. Through the transcriptions of the digital audio recordings one student stated, "Ms. Anna, you are the teacher with spice!" The student had said it with excitement. Other students concurred with her statement. I have received notes from the students with sentiments showing a positive attitude towards me, their mathematics teacher. Research (Goh & Fraser, 1995; Ring, Pape, & Tittle, 2000; Spinner & Fraser, 2002) stated that discourse and/or journal writing promote positive attitudes in the mathematics classroom.

Students' Conceptions in Mathematics

Theme 3: Through the use of discourse and journal writing in the classroom, students found that they had a lack of knowledge of basic mathematics facts and skills related to multiplication, division, and decimal place-value. The following are examples of the students' concepts with multiplication, division, and equalities.

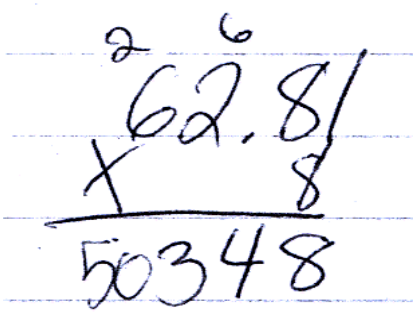
Student journal example 1: Multiplication Facts



Through the use of journal writing, student journal example 1 showed a student's multiplication facts as the problem. The concept of multiplying four digits by one digit was correct but the multiplication facts were incorrect. For example, 8 x 8 is 64 not 73. This was a typical example that was found in other students' journals as well. The following are examples of students' journal writing and discourse for the areas of multiplication, division, and equalities. One student stated on digital audio tape that he "needed to be more careful (when multiplying)." This was a typical statement students made: "I thought that 8 x 8 was 62 instead of 64." Another student stated that she

"needed to practice the multiplication tables." My observational notes concurred with the fact that some students had a lack of knowledge of the multiplication facts. I observed students working in the classroom and there were multiplication facts that were incorrect. I had them review the multiplication facts with their partner. I noted in my observational notes that the students smiled demonstrating positive attitudes towards the discussion with their partners and towards the mathematics. The research (Goh & Fraser, 1995; NCTM, 2000) also stated that discourse in the mathematics classroom can promote positive attitudes towards mathematics. The transcriptions from the digital audio recordings had typical statements from the students such as, "I am so glad I caught that mistake," and "Now I get it." These were typical examples found in the students' journals, during discourse in the classroom, and in my observational notes.

Student journal example 2: Decimal Placement



Another student conception found with the use journal writing was the placing of the decimal incorrectly or not at all in a multiplication problem. Students sometimes did

not place the decimal when needed in a multiplication problem. Another typical problem was students lining up the decimals, multiplying, and bringing the decimal down; similar to addition with decimals. Student journal example 2 shows the typical problem of not placing the decimal in a multiplication problem. With the use of discourse in the classroom, students' typical statement was, "I did the same thing!" From the analysis of my observational notes, I found that it was typical of some students to not place the decimal when needed in a multiplication problem. This conception was found in students' journals, in discourse in the classroom, in my observational notes. The research (Goh & Fraser, 1995; NCTM, 2000) also stated that discourse and journal writing in the mathematics classroom can promote positive attitudes towards mathematics. My observational notes showed that the students smiled demonstrating positive attitudes towards the discussion with their partners and towards the mathematics. The transcriptions from the digital audio recordings had typical statements from the students such as, "I won't forget to place the decimal anymore," and "Now I get it." Positive statements such as these showed that students had positive attitudes. These mathematical conceptions were typical examples found in the students' journals, during discourse in the classroom, and in my observational notes.

Student discourse example 3: Multiplication

$$\begin{array}{r} 30 \\ \times\ 60 \\ \hline \end{array}$$

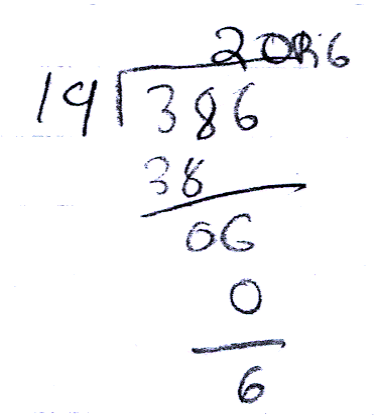
Through analysis of the transcription of the student discourse from the digital audio recordings, example 3 shows this student's mathematical concept. She said that she had, "added the numbers instead of multiplying." This was a typical example given. With the use of discourse in the classroom, other students spoke up saying that they had incorrect answers because of adding the factors instead of multiplying them. I observed other students doing the same addition instead of multiplying. The research (Goh & Fraser, 1995; Gonzales, 1998; NCTM, 2000) also stated that discourse in the mathematics classroom can promote positive attitudes towards mathematics and is a helpful method of teaching mathematics. My observational notes showed that the students smiled demonstrating positive attitudes towards the discussion with their partners and towards the mathematics. The transcriptions from the digital audio recordings had typical statements from the students such as, "I will pay more attention," and "Man, I can't believe I did that." Positive statements such as these showed positive attitudes. These were typical examples found in the students' journals, in discourse in the classroom, and in my observational notes.

Student discourse example 4: Multiplication

$$\begin{array}{r} 15 \\ \times\ 3 \\ \hline 35 \end{array}$$

Through the use of discourse, example 4 showed a typical student conception of not adding in the 10 traded ones for 1 ten when multiplying. For example, 3 ones times 5 ones equals 15 ones. The 1 in the tens place of the 15 was not carried to the tens place for the factor, 15. That is why the student came up with the answer of 35 instead of 45. Through discourse in the classroom, this recording showed a typical example of students not adding the traded tens after multiplying. Again, other students in the class stated that they had the same incorrect answer for the same reason. My observational notes showed that other students had the same problem. We discussed the problems and students corrected their errors. The research (Goh & Fraser, 1995; Gonzales, 1998; NCTM, 2000) has also stated that discourse is a helpful method of teaching mathematics in the mathematics classroom and can promote positive attitudes towards mathematics. My observational notes showed that most students smiled and seemed happy when discussing this problem which demonstrated positive attitudes towards the discourse with their partners and towards the mathematics. The transcriptions from the digital audio recordings had typical statements from the students such as, “I can’t believe I forgot that,” or “That’s a stupid mistake,” Students typically stated, “I can fix that by paying attention to my work.” Positive statements such as these showed positive attitudes. These were typical examples found in the students’ journals, on discourse in the classroom, and in my observational notes.

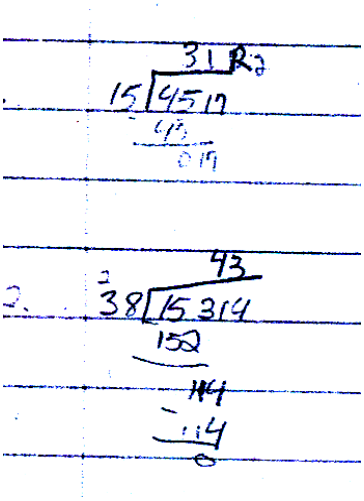
Student journal example 5: Division



I observed students demonstrate their conceptions with division through the use of their journals and explain their conceptions through the use of discourse in the classroom. Student journal example 5 showed a student's conception by multiplying incorrectly during the division process. For example, this example showed 14 x 2 = 28 not 38. This is a typical example found in students' journals. Again, some students multiplied incorrectly during the division process. Through discourse in the classroom when this concept was discussed, the typical answer was, "I multiplied wrong, too!" or "I can't believe I did that." My observational notes showed students' working with partners and their work having incorrect multiplication. I then observed students discussing with each other why their answers were different. Typically, this type of observation ended with the student saying, "Ohhhhhh," and correcting their mistake. My observational notes showed that the students smiled demonstrated positive attitudes towards the discussion with their partners and towards the mathematics. The transcriptions from the digital audio recordings stated that, I often asked the student, "What can you do to correct this

problem?" The typical response was, "I can be more careful, or I can check over my work." Positive statements such as these showed positive attitudes. The research (Goh & Fraser, 1995; Gonzales, 1998; NCTM, 2000) also stated that discourse and in the mathematics classroom can promote positive attitudes towards mathematics and is a helpful method of teaching mathematics. These were typical examples found in discourse in the classroom, and in my observational notes.

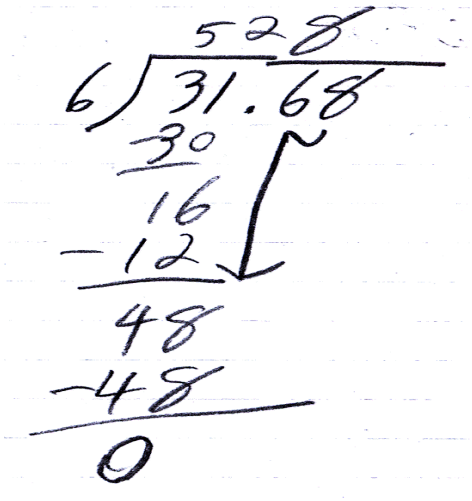
Student journal example 6: Division



Student journal example 6 demonstrated, through the use of journal writing, another student conception of missing the zeros in the quotient. In the first example 15 did go into 45, 3 times with nothing left over. Then the 1 is brought down and 15 did not go into 1, so a 0 should be in the quotient in the tens place after the 3. Then the 7 would be brought down to make 17 and 15 did go into 17, 1 time. After subtracting, 17 – 15 = 2,

this showed that the remainder was 2. The final answer should be 301 R2. In student journal example 6 the student's answer is 31 R2 and is missing the 0 in the tens place. In the second example this same student demonstrated the same conception by leaving out the zero in the tens place in the quotient. This was a typical problem with this type of division problem. We then discussed with our partners or other class members the next day why the zero was needed. Through analysis of my observational notes, I found that quite a few students had this same problem with division. Students disregarded place value in the example and other journal writings. The transcriptions from the digital audio recordings showed typical student statements of, "I can't believe I did that," or "I don't understand." More discussion with the partners and the teacher along with examples were given to address this error. I found that through discourse with their partner or with me, the student corrected this error. After more practice, my observational notes and student work demonstrated most students corrected this error. Then the digital audio recordings showed a typical student response would be "Ohhhhh." A positive statement such as this showed a positive attitude. The research (Goh & Fraser, 1995; Gonzales, 1998; NCTM, 2000) also stated that discourse and in the mathematics classroom can promote positive attitudes towards mathematics and is a helpful method of teaching mathematics. These were typical examples found in my observational notes, transcriptions of digital audio recordings, and student journal writings with the use of discourse and journal writing in the classroom.

Student journal example 7: Division



Another student conception with division found with the use of discourse and journal writing was not placing the decimal in the quotient. Student journal example 7 showed a student completing the division algorithm correctly and not placing the decimal in the quotient. This was a typical example from students' journals. Also, through discourse in the classroom other students commented that they had made the same error. When students were working in pairs, my observational notes corresponded with the journals and the discourse. I observed students discussing why their answers were different and typical reasons students gave were, "I forgot to place the decimal in the quotient," or "I can't believe I made such a simple mistake." My observational notes showed that students, when finding their error, were pleased upon finding out that remembering to place the decimal would be easy to overcome. This showed a positive

attitude towards the discourse and mathematics. Students' comments from the transcriptions of the digital audio recordings showed typical statements were "I can be more careful and remember to place the decimal in the quotient," or "I can check over my work." Positive statements such as these, showed positive attitudes. The research (Goh & Fraser, 1995; Gonzales, 1998; NCTM, 2000) also stated that discourse and in the mathematics classroom can promote positive attitudes towards mathematics and is a helpful method of teaching mathematics. These were typical examples found in discourse in the classroom, and in my observational notes.

Student discourse example 8: Equalities

½ = m¼

Another type of conception involved the equal sign and was found with the use of discourse and journal writing in the classroom. This example came from the mathematics textbook by Scott Foresman Addison Wesley (2001) for the students to complete. A typical statement from the students was, "This problem can't be solve," or "The problem is written wrong." Also, in some students' journals they just moved the ¼ to the ½ side and multiplied them together. We had completed similar type problems with whole numbers and multiplication. Through discourse in the classroom, one reason a student gave was "I knew I had to do something with the numbers." Predicting this would happen

from the research (Falkner & Levi, 1999) I had read, we were able to discuss this type of problem and the equals sign. I observed other students in the classroom demonstrating this same conception with the equals sign. After discourse and practice of how to solve this type of problem, the transcriptions from the digital audio recordings showed typical student statements of “That’s not hard,” or “Using fact families makes it easy.” Positive statements such as these showed positive attitudes. The research (Goh & Fraser, 1995; Gonzales, 1998; NCTM, 2000) also stated that discourse and in the mathematics classroom can promote positive attitudes towards mathematics and is a helpful method of teaching mathematics. These were typical examples found in discourse in the classroom, and in my observational notes.

All of these examples were discussed in the mathematics class through the use of discourse and journal writing. It never failed that when an error was mentioned in class, someone would say, “me too!” or something to that effect. Other students who did not have that error were able to explain how they came to the correct conclusion. Students’ discussing their methods in the classroom was time consuming but so valuable. The teacher’s job is to direct the discussion and help students discover meaningful knowledge. By asking questions such as “How did you complete the problem?” or “What did you do?” helped lead the students to explaining and realizing their errors or helping other realize their errors.

Summary of Results

Through the use of discourse and journal writing, students' attitudes towards mathematics had a positive change over the twelve week period. Students' attitudes towards discourse and journal writing in the mathematics classroom had a positive change. Finding students' mathematical concepts, through the use of these two teaching methods, was helpful in my classroom for the students to discuss how to complete a problem and explain the process. I observed students eagerly wanting to share the method they used to solve a problem. The analysis of the transcriptions from the digital audio recordings typically showed that when a student said, "awe" in class, that student was still willing to share and discuss what went wrong. Through discourse in the classroom, other students would then raise their hands and say they had done the same thing, too. Then others would offer their method of solving the problem. The use of discourse and journal writing in my classroom added to the students' sense of control and power in the mathematics classroom. Students were able to explain verbally or in the written language how a problem was solved and make the learning their own. The research (showed discourse and journal writing are effective methods of teaching mathematics.

In the next chapter, I concluded this study. I showed how the questions posed at the beginning of the study were answered through the use of observational notes, transcriptions of digital audio recordings, discourse, journal writing, and two administered attitude surveys. I also showed how the themes found during my research connected with the research.

CHAPTER FIVE: CONCLUSION

Introduction

The findings from this study showed that students demonstrated positive attitudes towards discourse and journal writing in the mathematics classroom. Through the use of two attitude surveys, observational notes, transcriptions of the discourse from the digital audio recordings, and journal writing in the mathematics classroom, students demonstrated their positive attitudes. Mathematical concepts were found in this study by using discourse and journal writing. Research (Alro & Skovsmose, 2002; Bickmore-Brand,1990; Gonzales, 1998; Lampert & Blunk, 1998; Murray, 2004) states that the use of discourse in the classroom helps promote student learning. Research (Alro & Skovsmose, 2002; Ashlock, 1976; Gonzales, 1998; Lampert & Blunk, 1998; Murray, 2004, Talman, 1982) also states that the use of journal writing in the classroom gives students and teachers another form of communication about mathematics. Students' positive attitude towards mathematics was supported through the research from Goh & Fraser (1995), Jurdak & Abu Zein (1998), Ring, Pape, & Tittle (2000), Zucker & Esty (1993), and Zucker & Fraser (1993).

Research Questions

Research Question #1: What are students' attitudes towards the use of discourse in the elementary mathematics classroom?

The results of this study showed that the students gained a more positive attitude towards the use of discourse in the 5th grade mathematics classroom. The Robustness Semantic Differential Survey demonstrated a positive student attitude toward discourse in the mathematics classroom. The research also stated that the use of discourse in the classroom is important for students to help them make the mathematical concepts their own. Through my experience and observations the use of discourse in the mathematics classroom is very important and helps students take ownership of their work. Mathematical concepts were found by using discourse in this study.

Research Question #2: What are students' attitudes towards journal writing in the elementary mathematics classroom?

The results of this study showed that the students gained a more positive attitude toward journal writing in the 5th grade mathematics classroom. The Robustness Semantic Differential Survey demonstrated a positive student attitude toward journal writing in the mathematics classroom. The research stated that journal writing is important to help students construct mathematical concepts. Mathematical concepts were found through the use of journal writing in the mathematics classroom. Through my experience and observations the use of journal writing in the mathematics classroom is very important and gives students a chance to reflect on the mathematical concept.

Discussion

The findings from this study showed students' attitudes toward discourse and journal writing in the classroom was positive. According to the research, discourse and journal writing can be a start towards helping students and teachers identify students' mathematical concepts. My observations showed students with a positive attitude toward discourse and journal writing in the mathematics classroom. The Robustness Semantic Differential attitude survey demonstrated students' positive attitudes towards discourse and journal writing in the mathematics classroom.

What I have found is that most of my students had error patterns as Ashlock (1976, 2002) demonstrated in his research. When the error pattern was discussed, the student moved toward constructing a new mathematical concept. What I feel we can do, as teachers, is expose students to common mistakes in the hopes that they try not to repeat those mistakes. Ashlock (2002) stated that if teachers know the error patterns that students can present during a lesson, the teachers can use this knowledge to guide instruction and help students construct mathematical concepts.

Although I have always integrated writing periodically during mathematical experiences, this study has helped me to see how important it is for teachers to use writing consistently and effectively throughout the mathematics curriculum as stated by numerous researchers (e.g. Bickmore-Brand, 1990; Sipka, 1982; Reeves, 1990). This study described the error patterns with mathematical conceptions that were discovered through the two teaching methods of journal writing and discourse. I will continue to use

journal writing and discourse in the future, while attempting to integrate these activities more frequently throughout my mathematics instruction.

One of the most surprising aspects of this study was the insight I gained as a teacher. I was able to more closely examine students' thought processes with the use of discourse and journal writing and more accurately address their mathematical conceptions. Using writing and discourse as tools for communication enabled me to better understand students' reasoning behind common errors made during calculations, and work to address students' errors of fundamental mathematics concepts such as multiplication facts and place-value. Writing and discourse provided me with an insight into students' thinking I could not have achieved otherwise, while helping to guide instruction and empower my students with the skills needed to become effective in mathematics as MacGregor (1990), Murray (2002), and Rittenhouse (1998) discussed in their writings. Students began discussing strategies with partners when their answers were different. These results are both encouraging and rewarding, reconfirming my commitment to the integration of discourse and journal writing in the mathematics classroom.

This study emphasized the importance of integrating discourse and journal writing throughout the mathematics curriculum. Student' attitudes towards discourse and journal writing were positive. Research also showed (Alro & Skovsmose, 2002; Bickmore-Brand, 1990; Lampert & Blunk, 1998; MacGregor, 1990; Miller, 1992; Murray 2004; Reeves, 1990; Sipka, 1982; Sterrett, 1982; Talman, 1982) that discourse and journal writing in the mathematics classroom are two teaching methods that are important to

student learning.

Recommendations

There are a few recommendations as a follow up to this study.

1. Research can be conducted on students' attitudes towards mathematics, the teacher and the teaching methods of discourse and journal writing have an impact on student performance by using quantitative research methods. Now that I know students have a positive attitude toward discourse and journal writing, I would like to know how the two teaching methods would impact student performance.
2. Teachers need more time to collaborate about students' different mathematical conceptions that can be expected during a mathematics lesson. Knowledge of these different mathematical conceptions can empower the teacher to help the student construct mathematical knowledge.
3. Teachers need more training on how to implement the use of discourse and journal writing in their classrooms. This should not be a hit or miss method. Knowing what to have the students write about, knowing how to expedite the writing in the classroom with ease, and knowing how to integrate the students writings into the mathematical lessons were important obstacles for me to overcome.

Classroom Implications

Classroom implications drawn from this study are important. Discourse and journal writing had a positive impact on students' attitudes toward the two teaching methods. Classroom environment plays a role with students' attitudes toward mathematics and toward the mathematics teacher. Teachers' can make the classroom environment a safe place for students to express their ideas and not feel threatened. Since students like the use of discourse and the use of journal writing in the mathematics classroom, these two teaching methods could be used in other areas of the curriculum. These two teaching methods helped students and teachers discover mathematical conceptions and work to continue constructing those mathematical concepts.

Conclusion

Discourse and journal writing had a positive impact on students' attitudes towards the two teaching methods in the mathematics classroom. The research showed that discourse is an important teaching method for teachers to use in the mathematics classroom. Giving the student a chance to express mathematical concepts, gives that student and the rest of the class another chance to think about the mathematical concept. The research also showed that journal writing is an important teaching method for teachers to use in the mathematics classroom. Students had a chance to write about a

particular mathematical concept. That gave the student another chance to think about that mathematical concept. Also, the journal writing gave me insight into the students' thinking and gave me a chance to respond about the mathematical concept. Students' positive attitudes towards discourse and journal writing in the mathematics classroom, make the two teaching methods very valuable to teachers.

APPENDIX A

Modified Fennema-Sherman Mathematics Attitudes Scales

Fennema-Sherman Mathematics Attitude Scales

Using this scale will help you and I find out how you feel about yourself and mathematics.

On the following pages is a series of sentences. You are to mark your answer sheets by telling how you feel about them. Suppose a statement says:

Example 1: I like mathematics.

As you read the sentence, you will know whether you agree or disagree. If you strongly agree, circle A next to Number 1. If you agree, but not so strongly, or you only "sort of" agree, circle B. If you disagree with the sentence very much, circle E for strongly disagree. If you disagree, but not so strongly, circle D. If you are not sure about a question or you can't answer it, circle C. Now, mark your sheet, then go on and do Example 2.

Do not spend much time with any statement, *but be sure to answer every statement.*

Work fast, but carefully.

There are no "right" or "wrong" answers. The only correct responses are those that are true *for you*. Whenever possible, let the things that have happened to you help you make a choice.

A Modified Fennema-Sherman Mathematics Attitude Scale

1.	I am sure that I can learn math.	A B C D E
2.	My teachers have been interested in my progress in math.	A B C D E
3.	Knowing mathematics will help me earn a living.	A B C D E
4.	I don't think I could do advanced math.	A B C D E
5.	Math will not be important to me in my life's work.	A B C D E
6.	Males are not naturally better than females in math.	A B C D E
7.	Getting a teacher to take me seriously in math is a problem.	A B C D E
8.	Math is hard for me.	A B C D E
9.	It's hard to believe a female could be a genius in mathematics.	A B C D E
10.	I'll need mathematics for my future work.	A B C D E
11.	When a woman has to solve a math problem, she should ask a man for help.	A B C D E
12.	I am sure of myself when I do math.	A B C D E
13.	I don't expect to use much math when I get out of school.	A B C D E
14.	I would talk to my math teachers about a career that uses math.	A B C D E
15.	Women can do just as well as men in math.	A B C D E
16.	It's hard to get math teachers to respect me.	A B C D E

17. Math is a worthwhile, necessary subject. A B C D E

18. I would have more faith in the answer for a math problem solved by a man than a woman. A B C D E

19. I'm not the type to do well in math. A B C D E

20. My teachers have encouraged me to study more math. A B C D E

21. Taking math is a waste of time. A B C D E

22. I have a hard time getting teachers to talk seriously with me about math. A B C D E

23. Math has been my worst subject. A B C D E

24. Women who enjoy studying math are a little strange. A B C D E

25. I think I could handle more difficult math. A B C D E

26. My teachers think advanced math will be a waste of time for me. A B C D E

27. I will use mathematics in many ways as an adult. A B C D E

28. Females are as good as males in geometry. A B C D E

29. I see mathematics as something I won't use very often when I get out of high school. A B C D E

30. I feel that math teachers ignore me when I try to talk about something serious. A B C D E

31. Women certainly are smart enough to do well in math. A B C D E

32. Most subjects I can handle OK, but I just can't do a good job with math. A B C D E

33.	I can get good grades in math.	A B C D E
34.	I'll need a good understanding of math for my future work.	A B C D E
35.	My teachers want me to take all the math I can.	A B C D E
36.	I would expect a woman mathematician to be a forceful type of person.	A B C D E
37.	I know I can do well in math.	A B C D E
38.	Studying math is just as good for women as for men.	A B C D E
39.	Doing well in math is not important for my future.	A B C D E
40.	My teachers would not take me seriously if I told them I was interested in a career in science and mathematics.	A B C D E
41.	I am sure I could do advanced work in math.	A B C D E
42.	Math is not important for my life.	A B C D E
43.	I'm no good in math.	A B C D E
44.	I study math because I know how useful it is.	A B C D E
45.	Math teachers have made me feel I have the ability to go on in mathematics.	A B C D E
46.	I would trust a female just as much as I would trust a male to solve important math problems.	A B C D E
47.	My teachers think I'm the kind of person who could do well in math.	A B C D E

APPENDIX B

Robustness Semantic Differential

Robustness Semantic Differential

Read each set of adjective pairs used to describe six aspects of your learning environment. For each adjective place a “check” in one of the five blanks that is nearest to describing your feeling about the particular aspect. For example, the adjective pair of “happy” and “sad” could be marked as follows.

happy _____:_____:_____:_____:_____ sad

The mathematics teacher is

1. boring _____:_____:_____:_____:_____ interesting
2. fresh _____:_____:_____:_____:_____ stale
3. meaningless _____:_____:_____:_____:_____meaningful
4. important _____:_____:_____:_____:_____unimportant
5. usual _____:_____:_____:_____:_____unusual
6. powerful _____:_____:_____:_____:_____ weak
7. passive _____:_____:_____:_____:_____ active
8. thrilling _____:_____:_____:_____:_____ quieting
9. uneventful _____:_____:_____:_____:_____ action-packed
10. challenging_____:_____:_____:_____:_____ dull

Journal writing is

11. boring _____:_____:_____:_____:_____ interesting
12. fresh _____:_____:_____:_____:_____ stale
13. meaningless _____:_____:_____:_____:_____meaningful
14. important _____:_____:_____:_____:_____unimportant
15. usual _____:_____:_____:_____:_____unusual
16. powerful _____:_____:_____:_____:_____ weak
17. passive _____:_____:_____:_____:_____ active
18. thrilling _____:_____:_____:_____:_____ quieting
19. uneventful _____:_____:_____:_____:_____ action-packed
20. challenging_____:_____:_____:_____:_____ dull

Mathematics activities are

21. boring _____:_____:_____:_____:_____ interesting
22. fresh _____:_____:_____:_____:_____ stale
23. meaningless _____:_____:_____:_____:_____meaningful
24. important _____:_____:_____:_____:_____unimportant
25. usual _____:_____:_____:_____:_____unusual
26. powerful _____:_____:_____:_____:_____ weak
27. passive _____:_____:_____:_____:_____ active
28. thrilling _____:_____:_____:_____:_____ quieting
29. uneventful _____:_____:_____:_____:_____ action-packed
30. challenging_____:_____:_____:_____:_____ dull

Mathematics activities with journal writing are

31. boring _____:_____:_____:_____:_____ interesting
32. fresh _____:_____:_____:_____:_____ stale
33. meaningless _____:_____:_____:_____:_____meaningful
34. important _____:_____:_____:_____:_____unimportant
35. usual _____:_____:_____:_____:_____unusual
36. powerful _____:_____:_____:_____:_____ weak
37. passive _____:_____:_____:_____:_____ active
38. thrilling _____:_____:_____:_____:_____ quieting
39. uneventful _____:_____:_____:_____:_____ action-packed
40. challenging_____:_____:_____:_____:_____ dull

Discussion in the classroom is

41. boring _____:_____:_____:_____:_____ interesting
42. fresh _____:_____:_____:_____:_____ stale
43. meaningless _____:_____:_____:_____:_____meaningful
44. important _____:_____:_____:_____:_____unimportant
45. usual _____:_____:_____:_____:_____unusual
46. powerful _____:_____:_____:_____:_____ weak
47. passive _____:_____:_____:_____:_____ active
48. thrilling _____:_____:_____:_____:_____ quieting
49. uneventful _____:_____:_____:_____:_____ action-packed
50. challenging_____:_____:_____:_____:_____ dull

Discussion with mathematics activities is

51. boring _____:_____:_____:_____:_____ interesting
52. fresh _____:_____:_____:_____:_____ stale
53. meaningless _____:_____:_____:_____:_____meaningful
54. important _____:_____:_____:_____:_____unimportant
55. usual _____:_____:_____:_____:_____unusual
56. powerful _____:_____:_____:_____:_____ weak
57. passive _____:_____:_____:_____:_____ active
58. thrilling _____:_____:_____:_____:_____ quieting
59. uneventful _____:_____:_____:_____:_____ action-packed
60. challenging_____:_____:_____:_____:_____ dull

APPENDIX C

UCF IRB Approval

Revised 6/04

THE UNIVERSITY OF CENTRAL FLORIDA
INSTITUTIONAL REVIEW BOARD (IRB)

IRB Committee Approval Form

PRINCIPAL INVESTIGATOR(S): Anna K. Rose **IRB #: 04-1978**

PROJECT TITLE: The Nature of Students" Misconceptions and whether Discourse and Writing are Effective Methods for Correcting Students' Misconceptions

Full Board
[ ] Contingent Approval
Dated: _____

[ ] Final Approval
Dated: _____

[ ] Expiration
Date: _____

Committee Members:

Dr. Theodore Angelopoulos: _____
Ms. Sandra Browdy: _____
Dr. Jacqui Byers: _____
Dr. Ratna Chakrabarti: _____
Dr. Karen Dennis: _____
Dr. Barbara Fritzsche: _____
Dr. Robert Kennedy: _____
Dr. Gene Lee: _____
Ms. Gail McKinney: _____
Dr. Debra Reinhart: _____
Dr. Valerie Sims: _____

Chair
[X] Expedited Approval
Dated: 15 July 2004

[ ] Exempt
Dated: _____

[x] Expiration
Date: 14 July 2005

Chair, IRB

Signed: _____
Dr. Sophia Dziegielewski

NOTES FROM IRB CHAIR (IF APPLICABLE): _____

APPENDIX D

Parent Consent

Dear Parents,

I am currently enrolled in the Lockheed Martin Academy at University of Central Florida working on my masters. This school year I will be writing my thesis and conducting research with the help of my Thesis Chair, Dr. Ortiz, who is a professor at the University of Central Florida. My action research will investigate the effects on student prior conceptions with the use of discourse and journal writing in my 5th grade mathematics classroom. I will be using my 5th grade mathematics classes at Lake Mary Preparatory. The students will include all of 5th grade. There will be no compensation given to my students. Participation or nonparticipation in this study will in no way affect the children's grades or placement in any programs. No grades or points will be given for participation in the research. Students will not be penalized for nonparticipation. Students who do not wish to participate in this study will begin class assignments, which will engage them during the time allotted to complete pre and post assessments and journals. I will be audio and video taping your child. The video and audio tapes will be locked in a filing cabinet when they are not being used by me. After the research is complete, the video and audio tapes will be destroyed. Student identities will be protected by the changing of names. This study will benefit your child by helping research the teaching methods used and understanding student attitudes towards these teaching methods.

I appreciate your help. I will be happy to share my research findings next year when my thesis is published. If you have any questions, please email: anna@lakemaryprep.com or call 407-805-0095 and ask for Ms. Anna.

Sincerely,
Ms. Anna Rose

Please cut and return the bottom portion

I have read the procedure described above and I voluntarily agree to allow my child, _____ to participate in Ms. Anna Rose's action research
(Student name)
study and I have received a copy of this description.

Yes, my child may participate _____ _____
Parent/Guardian signature Date

No, my child will not participate _____ _____
Parent/Guardian signature Date

APPENDIX E

Student Assent

Dear Student,

I am currently attending UCF and working on my Masters Degree in Mathematics and Science for Elementary Education. I will be conducting research with all three of my 5^{th} grade mathematics classes. There will be no compensation given to my students. Participation or nonparticipation in this study will in no way affect the children's grades or placement in any programs. No grades or points will be given for participation in the research. Students will not be penalized for nonparticipation. Students who do not wish to participate in this study will begin class assignments, which will engage them during the time allotted to complete pre and post assessment and journals. I will be audio and video taping you. The video and audio tapes will be locked in a filing cabinet when they are not being used by me. After the research is complete, the video and audio tapes will be destroyed.

I would appreciate your help.

Sincerely,

Ms. Anna Rose

Yes, I will participate _____ _____

Signature Date

No, I will not participate _____ _____

Signature Date

LIST OF REFERENCES

Alro, H. & Skovsmose, O. (2002). *Dialogue and learning in mathematics education*. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Ashlock, R. (1976). *Error patterns in computation a semi-programmed approach*. Columbus, Ohio: Charles E. Merrill Publishing.

Ashlock, R. (2002). *Error patterns in computation using error patterns to improve instruction*. Upper Saddle River, New Jersey: Pearson Education.

Bickmore-Brand, J. (Ed.). (1990). *Language in mathematics*. Victoria, Australia: Australian Reading Association.

Bratina, T. & Lipkin. L. (2003, Spring). Watch your language! Recommendations to help students communicate mathematically. *Reading Improvement,* 40(1), p 3.

Caine, G., Caine, R., & McClintic, C. (2002, September). Guiding the innate constructivist. *Educational Leadership,* p 70-73.

Chrenka, L. (2001, May). Misconstructing constructivism. *Phi Delta Kappan,* 82(9), p 694.

Cicero, A., De La Cruz, Y., & Fuson, K. (1999). Teaching and learning creatively: Using children's narratives. *Teaching Children Mathematics,* 5(9), 544-548.

Clarke, D., Waywood, A., & Stephens, M. (1993). Probing the structure of mathematical

writing. *Educational Studies in Mathematics*, 25(3), 235-250.

Curcio, F. & Artzt, A. (2003). Reflecting on teaching mathematics through problem solving. In F. K. Lester, Jr. (Ed.), *Teaching mathematics through problem solving prekindergarten-grade 6* (p 131). Reston, VA: The National Council of Teachers of Mathematics.

Dewey, John (1916). *The Middle Work 1899-1924*. Southern Ill. University Press.

Diaz-Obando, E., Plasencia-Cruz, I. & Solano-Alvarado, A. (2003). The impact of beliefs in student's learning: An investigation with students of two different contexts. *International Journal of Mathematics Education in Science and Technology*, 34(2), 161-173.

Driver, R., & Easley, J. (1978). Pupils and paradigms: a Review of literature related to concept development in adolescent science students. *Studies in Science Education*, 5, p 61-84.

Falkner, K. (1999, December). Children's understanding of equality: a Foundation for algebra. *Teaching ChildrenMathematics*, 6(4), p 232.

Fennema, E. & Sherman, J. (1976). Fennema-Sherman mathematics attitudes scales: Instruments designed to measure attitudes towards the learning of mathematics by females and males. *Journal for research in mathematics education*, 7, p 324-326.

Field, R. (2001). *John Dewey (1859-1952).* Retrieved: September 3, 2003. from http://www.utm.edu/research/iep/d/dewey.htm

Fuys, D.J., & Liebov, A.K. (1997, January). Concept learning in geometry. *Teaching Children Mathematics*, 3(5), p 248.

Goh, S. & Fraser, B. (1995, April). *Learning environment and student outcomes in primary mathematics classrooms in Singapore.* (ERIC Document Reproduction Service No. ED389627).

Gonzales, N. (1998, December). A blueprint for problem posing. *School Science & Mathematics,* 98(8), p 448.

Grade Level Expectations for the Florida Sunshine State Standards – Mathematics fifth grade. (2004). Retrieved: January 1, 2004, from http://www.myfloridaeducation.com/

Hendriksen, M. (1982). You can and should get your students to write in sentences. In A. Sterrett (Ed.), *Using writing to teach mathematics*. (p. 107-112) United States of America: Mathematical Association of America.

Jaworske, B. (1993). Constructivism and Teaching – The socio-cultural context. Retrieved: September 3, 2003. from http://www.grout.demon.co.uk./Barbara/chreods.htm

Jurdak, M. & Abu Zein, R. (1998). The effect of journal writing on achievement in and attitudes toward mathematics. *School Science and Mathematics,* 98(8), 412-419.

Kamii, C. & Lewis, B. (January, 1993). The harmful effects of algorithms…in primary arithmetic. *Teaching K-8,* p.36-38.

Lampert, M. & Blunk, M. (Eds.). (1998). *Talking mathematics in school studies of teaching and learning.* Cambridge, UK: Cambridge University Press.

Licata, J. & Willower, D. (1978, March/April). Toward an operational definition of environmental robustness. *The Journal of Educational Research,* 71(4), p 218-

222.

Ma, X. (2003). Effects of early acceleration of students in mathematics on attitudes toward mathematics and mathematics anxiety. *Teachers College Record,* 105(3), 438-464.

MacGregor, M. (1990). Reading and writing in mathematics. In J. Bickmore-Brand (Ed.) *Language in mathematics,* p 100-108. Victoria, Australia: Australian Reading Association.

Miller, D. (1992). Teacher benefits from using impromptu writing prompts in algebra classes. *Journal for Research in Mathematics Education,* 23(4). p 329-340.

Mills, G. (2003). *Action Research: a Guide for the teacher researcher 2nd edition,* Upper Saddle River, New Jersey: Merrill Prentice Hall.

Monaghan, Frank (2000). What difference does it make? Children's views of the differences between some quadrilaterals. *Educational Studies in Mathematics*, 42, p 179-196.

Mulhern, F. & Rae, G. (1998, April). Development of a shortened form of the Fennema-Sherman mathematics aptitudes scales. *Educational and Psychological Measurement,* 58(2), p 295-306.

Murray, M. (2004). *Teaching mathematics vocabulary in context*. Portsmouth, NH: Heinemann.

National Council of Teachers of Mathematics (2000). *Curriculum and Evaluation Standards for School Mathematics.* Reston, VA: National Council of Teachers of Mathematics.

Pengelly, H. (1990). Acquiring the language of mathematics. In J. Bickmore-Brand (Ed.) *Language in mathematics,* (p. 90-99). Victoria, Australia: Australian Reading Association.

Piaget, J. (1964). Cognitive development in children: Piaget development and learning. *Journal of Research in Science Teaching*. 2, 176-186.

Phillips, D. (1995, October). The good, the bad, and the ugly: the Many faces of constructivism. *Educational Researcher,* 24(7). 5-12.

Pugalee, D. (1997). Connecting writing to the mathematics curriculum. *Mathematics Teacher,* 90(4), 308-311.

Quinn, R. & Wilson, M. (1997). Writing in the mathematics classroom: Teacher beliefs and practices. *Clearing House,* 71(1),14-21.

Reeves, N. (1990). The mathematics-language connection. In J. Bickmore-Brand (Ed.) *Language in mathematics,* (p. 90-99). Victoria, Australia: Australian Reading Association.

Ring, R., Pape, S., & Tittle, C. (2000, February). *Student attitudes in a reformed mathematics classroom,* (ERIC Document Reproductive Service No. ED 437288).

Rittenhouse, P. (1998). The teacher's role in mathematical conversation: Stepping in and stepping out. In M. Lampert and M. Blunk (Eds.) *Talking mathematics in school studies of teaching and learning,* (p. 170) Cambridge, UK: Cambridge University Press.

Sample, C. (1998). Urban Algebra I students' perceptions of journal writing and its

effects on achievement with integers and students' attitudes toward mathematics. *Digital Dissertations*, (UMI No. AAT 9842390).

Siegel, M. & Fonzi, J. (1998). Supporting students' mathematical inquiries through reading. *Journal for Research in Mathematics Education*, 29(4), 378-414.

Sipka, T. (1982). Writing in mathematics: a Plethora of possibilities. In A. Sterrett (Ed.), *Using writing to teach mathematics*. (p 11-16) United States of America: Mathematical Association of America.

Smith, J.P., diSessa, A. A., & Roschelle, J. (1993). Misconceptions reconceived: a Constructivist analysis of knowledge in transition. *The Journal of the Learning Sciences*, 3(2), p 115-163.

Spinner, H. & Fraser, B. (2002, April). *Evaluation of an innovative mathematics program in terms of classroom environment, student attitudes, and conceptual development*, (ERIC Document Reproductive Service No. ED 464829).

Stephan, M. & Whitenack, J. (2003). Establishing classroom social and sociomathematical norms for problem solving. In F. K. Lester, Jr. (Ed.), *Teaching mathematics through problem solving prekindergarten-grade 6* (p 153). Reston, VA: The National Council of Teachers of Mathematics.

Sterrett, A (1982). *Using writing to teach mathematics*. United States of America: Mathematical Association of America.

Talman, L. (1982). Weekly journal entries – An effective for teaching mathematics. In A. Sterrett (Ed.), *Using writing to teach mathematics*. (p 107-112) United States of America: Mathematical Association of America.

Tirosh, D. (2000, January). Enhancing prospective teachers' knowledge of children's conceptions: the Case of division of fractions. *Journal for Research in Mathematics Education,* 31(1), p 5.

Vace, N. (1994, February). Planning for instruction: Barriers to mathematics discussion. *Arithmetic Teacher,* 41(6), p 339.

Verschaffel, L., De Corte, E. & Vierstraete, H.(1999, May). Upper elementary school pupils' difficulties in modeling and solving nonstandard additive word problems involving ordinal numbers. *Journal for Research in Mathematics Education,* 30(3), p 265.

Wade, E. (1994). A study of the effects of a constructivist-based mathematics problem-solving instructional program on the attitudes, self-confidence, and achievement of post-fifth-grade students. *Digital Dissertations,* (UMI No. AAT 9510417).

Whitin, P. & Whitin, D. (2002, December). Promoting communication in the mathematics classroom. *Teaching Children Mathematics,* 9(4), p 205.

Wickett, M. (2000, February). Nurturing the voices of young mathematicians with dyads and group discussions. *Teaching Children Mathematics,* 6(6), p 412.

Zucker, A. & Esty, E. (1993, April). *Promoting discourse in mathematics classrooms using a new video series for middle schools,* (ERIC Document Reproductive Service No. ED 367534).