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USING CONTENT READING STRATEGIES IN FOURTH GRADE MATHEMATICS CLASS

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ABSTRACT

This qualitative research study examined the effects of using content reading strategies with fourth grade students while reading math texts. The participants were 22 fourth grade students in a low-ability math class. The students were introduced to a variety of content reading strategies to use while reading their math text and reading Math Literature.

This study proposes that explicit instruction in content reading strategies within math class has many benefits. Students' use of text, response to text, collaboration, and real-life connections to text improved with explicit strategy instruction. Increased metacognitive awareness was shown through student's verbal and written explanations and independent work. Student achievement and motivation were better while using content reading strategies. Increased participation in lessons, enthusiasm, peer praise, and leadership were observed throughout this study. An improvement in students problem-solving strategies resulted from explicit content reading strategy instruction as well.

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RESEARCHER STANCE

I had always thought of myself as a good student. Even though tracking was done regularly in my elementary school, I was in the top reading group each year. Math was never a problem for me either, until sixth grade. In sixth grade I was tracked into a middle-level math class. We were given a test one day that decided where we would be placed. At first, I felt as though this was a challenge. I was convinced that I did not belong in that class. I belonged in the high math class. I would work hard and show the teachers that I was just having a bad day on the day of the test. But as the year went on and I struggled to make even a B in the middle-level class, I began to think that I did not belong in the advanced class. I realized that I belonged in the middle. I began to dislike math.

In junior high I was in average math classes. I liked my teachers, but I did not try very hard. I only needed to do enough to stay in the middle. I was uninspired and lost some of my excitement for learning. I was far enough behind the smart math kids now to not be able to catch up. I would never be in a top math class. I liked my teacher in ninth grade and began to get some of that excitement back. I really understood how she taught math and enjoyed the class. Then in tenth grade, I felt like that sixth grader all over again. The teacher did not teach us math. He told us to read in our books and do homework. We tried to work together as a

class to teach each other math, but the best I could do was C work. I guess I never learned how to use my math text book. The teacher expected me to be able to learn from the math text without teaching me how to read it. I was a great reader, but I was not able to understand math from the text. All of those feelings of not being smart in math came back again.

By the time I was a senior, I was convinced that math was just not my subject. I would need to go to college and study something that did not involve math. Then, as my senior year went on, my feelings about math changed again. I was achieving high grades in math and was at the top of my class. I really understood what I was learning. I was tutoring other students in math. My teacher even asked me why I was not in the advanced class learning Calculus. I am not sure what he did differently, but it worked for me. This teacher held us responsible for our own learning. There was hope for my math future once again.

I decided to become a teacher partly because I was inspired by my math teacher in my senior year of high school. I wanted to affect other kids in the way he affected me. I was inspired and excited about learning. I wanted to do that for other people.

I taught first grade for seven years and considered myself to be an important part in the reading lives of my students. Most students came to

me with little or no reading ability and left my class with many skills to read. I spent much of first grade teaching vocabulary, decoding skills, phonemic awareness, and comprehension. Math was important, but not difficult for many students and fairly easy to teach. When you teach first grade, reading is your top priority.

As I began my master's degree at Moravian, I had many ideas for pilot studies that would start me on my action research path. I had such a strong reading background and felt very comfortable teaching reading to my students. Most of our school district in-services and conferences that I had attended were in reading and writing. Math was an area where I felt less confident and knew I could improve in teaching with some new techniques. The first study I completed was on differentiated instruction in math. It was exciting to provide my students with differentiated learning opportunities in math class through the use of math centers. I felt more empowered and confident in my math teaching. The students were more excited about math class as well. Following this study, I went back to my emphasis on reading and learning about reading. The next pilot study I conducted was on tape-assisted reading. The students read along with taped text to help improve reading fluency. Both studies I conducted in first grade helped to improve my teaching. These studies also helped me to gain awareness about conducting qualitative research.

Reading became my passion in teaching. There were, however, difficulties in teaching reading. If someone asked my students why they were learning to read, they would say so that they could learn from a book or enjoy a book. Many of them could read a book for enjoyment, but few could learn from a book. They just did not develop the skills to learn something from reading a book. I found that content text, even in first grade, was difficult for students.

During my eighth year of teaching, I changed grade levels, moving from first to fourth grade. I still considered myself to be a reading teacher, although the texts looked much different. The focus became more on comprehension skills, especially written comprehension. The students participated in literature circles. They learned the difficult skills of summarizing and inferring. They also learned comprehension monitoring strategies. The greatest change from first grade, however, came with the added content. The students were now given grades in science and social studies, and the math concepts were more difficult with multi-step problems. The texts for these content areas were long, difficult pieces filled with vocabulary and concepts that were hard for the students to understand.

Math became my greatest daily challenge. I was teaching math content that I had not seen in many years to a low-ability group of

students. Math was the first subject of the day. I began each day with anxiety and anticipation. There were days that I felt so unsure of the content that I knew the students would not understand what I was teaching. They felt my anxiety. They also were aware that the other math class was moving much faster than we were. There was no excitement about math. The students did not seem interested in learning math. Every lesson became a chore to be completed. I was exhausted after math each day. I felt like I was doing so much teaching, but they were not getting it. They just watched the time tick away on the clock, hoping for math class to be over. I referred to this as survival. I was just trying to get through the year, and so were my students. The negative feelings I had throughout my school experiences had come back again.

Passion and excitement were missing in my math class. The students did not understand the math text and had difficulty with concepts. I needed to do something different. I wanted to help and inspire them to like math. I decided to try this through content reading. I would take my passion for reading and pair it with the push in my district to teach content reading strategies in the intermediate grades. I could teach my students strategies that could possibly help them become better math students throughout the rest of their schooling.

The other content areas were also difficult to teach. My teaching partner, as the social studies teacher for the fourth grade, spent most of his free time creating graphic organizers and cloze activities that would help the students read their social studies text. He found this to be the only way the students could begin to understand the concepts that were presented in the reading. I, as the science teacher, found the science reading to be as difficult for the students as the social studies text. I was spending my free time creating study guides and cloze activities as well. The students could not read the text alone to understand the concepts. We spent many class periods reading and discussing the text, mostly with the students reading and me paraphrasing the text for students. I felt like I was doing all of the work, and the students were not benefiting from this instruction. They were just repeating my words on the tests. The math text seemed to be useless. Most of my math lessons were presented by working through examples of problems on the board and worksheets. The students were not being taught how to use the text to their benefit. I felt that there had to be a better way.

I knew that the students were capable of understanding the text in math. They could understand complex plots and characters in their fictional stories. They were able to write summaries of chapter books to present each month. They were even making progress with

comprehension monitoring strategies and inferences. The students were aware of the strategies they were using to understand fiction, but were unable to transfer these strategies to content text. I realized that they needed explicit strategy instruction with the content area text to enable their use of these strategies. Through this type of instruction, students may be able to identify and use strategies to support their reading and understanding of content area texts.

The reason we teach students to read is so that they can eventually read to learn. This process is supported throughout the grade levels. Students in primary grades spend about half of their school day in reading instruction. This decreases slightly in the intermediate grades due to the added weight of content area instruction. The amount of time spent in reading instruction in middle and high school then decreases significantly, although we expect students to incorporate their reading skills into content texts. Students are expected to read materials with increasing difficulty, but with less reading instruction. My passion for reading led me to this study. I wanted to supply my students with tools to benefit them throughout the grade levels.

I became familiar with content reading strategies after taking a class on reading and writing across the curriculum. I then participated in workshops offered through my school district on Academic Literacy. I

learned many strategies that could be used to support students' content reading. The issue of content area reading is obviously of great importance. This led me to my research question: What will be the observed and reported experiences when comprehension strategies are used by elementary students while reading math texts?

LITERATURE REVIEW

Introduction

In order to understand content reading strategies, we need to examine the literature regarding these strategies within the context of elementary school. In elementary school classrooms, the students are at various ability levels. Teachers are challenged with meeting the needs of these diverse learners. They are also challenged in using developmentally appropriate practices with students.

There are many consistencies in the research on content area reading strategies. Recommendations for reading and comprehending content text include vocabulary instruction (Harmon, Hendrick, & Wood, 2005), using text structure (Barton, Heidema, & Jordan, 2002), activating prior knowledge (Mallett, 1992), and discussion of text (Hess, 1991). These strategies have been used in elementary school and are easily adaptable to the fourth grade curriculum. The use of literature in mathematics has also proven to be beneficial for students in content reading strategies, understanding of mathematical concepts, and improved problem solving skills.

Elementary Level

Developmentally Appropriate Practices

Teachers are aware of students' developmental differences within the classroom and the differences of students at various grade levels. It is often the difficult job of the teacher to take the students to a level of learning that seems out of their developmental reach.

In a study of developmentally appropriate practices in mathematics with first and second grade students, Gelzheiser, Griesemer, Pruzek, and Meyers (2000) found "no relationship between student achievement and use of developmentally appropriate or traditional teaching practices" (p. 234). They defined developmentally appropriate practices as specific instructional strategies, including student choice in learning activities, student interest consideration, use of manipulatives, integrated subjects, and shared parallel decision making with students. These practices were compared with traditional teaching practices in mathematics, such as whole-group instruction, homogenous grouping, and the use of worksheets. Neither type of instruction had a more positive impact on student achievement than the other, as measured on curriculum based assessments. Therefore, the authors could not support either type of instruction. On measurements of math achievement, both types of instruction noted similar results on curriculum based math assessments. It

is important to note, however, that students with learning disabilities did not receive the necessary individual attention that would be given in a small-group setting. These students showed significantly lower achievement when left in a large-group setting without individualized instruction. This supports the need for special instruction for lower-ability learners and the importance of meeting the needs of all learners.

Comprehension strategies are found to be developmental in acquisition. Although students may be instructed in some comprehension strategies in early grades, this instruction should be provided along a developmental continuum, according to Smolkin and Donovan (2001). They examined the instructional strategies in comprehension used by a first grade teacher during Read-Alouds. It was found that even at a first grade level, students were exposed to many important comprehension strategies. They concluded that the amount of strategy instruction should increase throughout the school years, and early exposure to these strategies is important to student development.

Vacca (2002) supports ongoing strategy instruction, especially in the middle grades. He cites a dangerous assumption that is often made regarding middle level readers. “An early literacy emphasis assumes that once children learn to read and write, they will be able to use reading and writing to learn for the rest of their lives” (p. 7). The need for continued

strategy instruction begins with fourth-grade students and continues through middle school.

Fourth-grade students have shown in studies that they are able to apply learned strategies to comprehend informational text and apply this learning to new situations. Dreher, Davis, Waynant, and Clewell (1997) examined the effects of research strategy instruction on fourth-grade students' abilities to independently understand a research question, locate information, respond to the question, and apply learning to new situations in two different schools with different ability readers. They found significant increases in students' use of appropriate resources and note-taking on those resources during independent research. They also found significant increases in their ability to apply learning to another situation.

Meeting the Needs of Diverse Learners

Teachers are challenged on a daily basis in meeting the diverse needs of learners in their classrooms. They want all students to achieve at a high level, but must support this in different ways depending on the learner. All students should be able to independently apply the information they read in the content texts. With students starting at varying starting points, it is our job to support them in their acquisition of these skills.

Collaboration and talk. In a case study by Mallett (1992), the diverse needs of her students were met through collaboration and talk.

The nine and ten year-old students in this case study were involved in writing informational picture books about squirrels to be read by seven year-old students. The students used research methods to create an informational book about squirrels. They read varying texts about squirrels, as well as watching an informational video. The most integral part of this study was the use of discussion beginning and following each research session. The students were given the opportunity to verbalize what they had read and compare notes with other students. The students not only discussed their factual information about squirrels, but also their challenges and successes with the different texts. Mallett (1992) stated in her findings that, “It was the sharing of ideas both about the phenomena under scrutiny--squirrels--and about the features of the books being used that seemed to promote progress” (p. 58). This collaborative process promoted student learning from informational texts. The teacher was able to mediate learning of diverse students through talk.

Hess (1991) found similar value in the use of talk to help students understand content texts. She used talk as a part of a method she created for students to understand nonfiction texts. Through talk the students had to clarify facts from the text. This often forced students to reread the text to further clarify their understanding of facts or fine-tune their understanding. “Through talk the students took ownership of the information. The new

knowledge became their own” (p. 231). The students were able to compare their facts with others through collaboration. The students felt more confident with their findings when working with a partner. Students have strengths in different areas, which benefits collaborative processes. They can support one another in comprehension of content texts when working collaboratively and talking about their reading.

Vocabulary instruction. Another way of supporting struggling students in content texts is through vocabulary instruction. Vacca and Vacca (2005) recognized that students who are struggling readers or English language learners may lack the vocabulary knowledge that is needed for comprehension of content texts. They described several strategies that help students in meaning building for key terms. Harmon, Hedrick, and Wood (2005) also recognized the need for vocabulary instruction with struggling readers in content areas. Through examination of various content area texts, they concluded that, “The students reading these excerpts during a typical school day are bombarded by a wealth of concepts represented by many unfamiliar terms that many times are not integrated across content areas” (p. 263). Suggestions for supporting students’ math vocabulary acquisition include the use of graphic organizers and categorizing words.

Similarly, both Vacca and Vacca (2005) and Harmon, Hendrick, and Wood (2005) described the need for instruction to improve struggling readers' independent strategies for acquiring new vocabulary. Vacca and Vacca (2005) stated, "Demonstrating how to use *context, word structure,* and the *dictionary* provides students with several basic strategies for vocabulary learning that will last a lifetime" (p. 124). By using these strategies, the struggling reader can make sense of the text without losing the meaning.

Activating prior knowledge. The prior knowledge that students bring to a content reading selection is important in their comprehension of that text. The background students bring to a lesson will vary greatly. Some students will not automatically make the connection to prior learning. Barton, Heidema, and Jordan (2002) asserted that "activating students' prior knowledge prepares them to make logical connections, draw conclusions, and assimilate new ideas" (p. 28). Some suggestions for activating prior knowledge include discussions, webbing, and Anticipation Guides.

Mallett (1992) also recognized the importance of activating prior knowledge in her case study. She did this through discussion of squirrels and vocabulary instruction to support their inquiry. Mallett (1992) showed a video on squirrels to help students begin with a similar knowledge base

on squirrels. She used the information from the discussion to plan experiences for students and gauge the ability of students as related to appropriate texts. In both cases we see the importance of activating prior knowledge. Students need to have experiences to draw upon and relate to for comprehension to occur.

Metacognitive awareness. As with other strategies, metacognitive awareness varies from student to student. Craig and Yore (1995) found varying metacognitive awareness of science reading strategies among a group of fourth through eighth grade students of varying reading abilities. The students could identify reading strategies they could use to help them read science text, but “the procedures they described for implementing the strategies were not carried out in the most efficient way or the identified strategies were not the most efficient way to achieve their goal” (p. 202). The students were aware of some reading strategies, but were not using them or not using them properly. It was also found that the students were using reading strategies, but lacked content reading strategies. Vacca and Vacca (2005) stressed the importance of explicit strategy instruction and how it supports students’ metacognition. Through strategy instruction, students will begin to use strategies independently and become responsible for their own learning. They become aware of their own learning process and what they need to do to achieve at a higher level.

Spence, Yore, and Williams (1999) found that explicit strategy instruction improved metacognition in seventh-grade students. Over a 22 week period, seventh-graders were instructed in many strategies for reading science texts. There were significant gains in awareness, self-management, and comprehension of text. They were able to make a connection between improved metacognition and explicit text reading strategy instruction.

Through the creation and verification of the Index of Science Reading Awareness (ISRA), Yore, Craig, and Maguire (1998) found that even fourth grade students had some knowledge of content reading strategies. The ISRA is aimed at measuring students' metacognition in reading science texts. The study reports that as students move through grade levels, metacognitive awareness of science reading, text awareness, and strategy awareness do not consistently increase. This is explained by the lack of explicit reading instruction as students move through grades. A significant difference was also found between high-ability and low-ability readers. Emphasizing metacognitive strategies in content area instruction with lower-ability students may be a key in improving the reading ability of these students.

Another study in support of students' metacognitive awareness was done by Dreher, Davis, Waynant, and Clewell (1997). This study on

fourth-grade student research projects found that the students were able to give strategy advice to other students after completing their own research reports. There was a significant difference in the type of advice given by students from the beginning to the end of the study. The students were aware of their own metacognition and then able to give advice to other students for future research.

Content Area Reading Strategies

Content Strategies for All Content Areas

Instruction in the area of content reading is important for students to be able to comprehend texts. Research in this area has shown similarities in planning instruction in all content areas. These instructional strategies include activating prior knowledge, setting a purpose for reading, vocabulary instruction, text structure awareness, collaboration, and discussion. Vacca (2002) stated, “Content literacy instruction practices help shape the comprehension strategies students need to think deeply about texts” (p. 7).

There are many challenges students face when reading content texts. Students need specific skills to overcome these challenges, which may not have been instructed in reading lessons. Barton, Heidema, and Jordan (2002) reported on strategies that math and science teachers can use to help students overcome these challenges. They suggest that

activating prior knowledge, mastering vocabulary, and making sense of text style in various instructional strategies support reading in content areas.

Using graphic organizers has also been proven beneficial to students reading comprehension in the content areas. Agnello, Jockl, Pearson, and Velasco (1998) examined the use of graphic organizers with students in content areas. It was found that students, both impaired and gifted, benefited from the use of graphic organizers to comprehend content text. The graphic organizers promoted active reading strategies since they can be used at any stage of the reading. The students benefited most from teacher-made graphic organizers, although some students also benefited from creating their own.

Mathematics Strategies

In a study of content reading strategies in a mathematics classroom, Borasi, Siegel, Fonzi, and Smith (1998) found significant increases in students' abilities to make meaning from text and participation in classroom discussions. One of the strategies described in the article, Say Something, is a collaborative strategy that encourages students to work together to make meaning from the text. Students work with a partner to talk to the text. The students then stop at points in the text to discuss their feelings, share their challenges, ask questions, discuss and

connect to prior knowledge, rephrase the selection, or state hypotheses. They are able to monitor their own understanding and make meaning in their own ways using this strategy.

The reading and comprehension of a math text involves understanding a variety of vocabulary, symbols, and text formats. Students must be able to use the text properly to be an independent learner. Reehm and Long (1996) urged “the best place to teach the specific reading skills necessary for mathematics is in the mathematics classroom rather than in a separate reading course” (p. 36). They suggested instruction and use of math vocabulary in relation to classroom activities. The students should be involved in reading and writing the vocabulary and symbols. Teachers can also encourage vocabulary acquisition by examining the roots and by changing prefixes and suffixes of math vocabulary. Math texts should be read carefully and slowly, accompanied by pencil and paper for calculations or drawing of diagrams. The text should be discussed for clarification of topics. Teachers may also use Think Alouds to help students interpret information given in graphs or diagrams. Draper (2002) agreed that teachers in mathematics classrooms need to instruct students in text reading strategies. She stated that, “More important than learning how to read the textbook is learning how to read, write, listen, speak, and think math texts” (p. 523). Content reading

strategies engage students in the text and support their understanding not just as reading comprehension, but as math reading comprehension.

Wood (1992) also wrote about content reading strategies to be used in mathematics instruction. Similar to those used by Borasi, Siegel, Fonzi, and Smith (1998), Wood's (1992) strategies are collaborative and require students to discuss their thinking. The five strategies described by Wood (1992) include: paired or group retellings, Reaction Guide, List-Group-Label, Interactive Reading Guide, and Capsule Vocabulary. Wood also encouraged the use of these strategies at all grade levels. "The strategies provide ways to increase students' conceptual knowledge of mathematics through the communication processes of reading, writing, listening, and speaking" (p. 97).

Science Strategies Relevant for Math Class

In a study examining the amount and type of reading instruction that was occurring in middle school science classrooms, Laine, Bullock, and Ford (1998) found that the largest percentage of class time was spent on oblique reading instruction. This is instruction not related to a specific text or assignment. They found that when active reading strategies were used, it was mostly with the teacher reading aloud or students reading silently while the teacher was instructing. The research noted that many important active reading strategies, such as building background,

vocabulary instruction, and application of content reading strategies, were overlooked during instruction. These strategies are important for math instruction as well.

Instruction in content reading strategies has proved to be beneficial to students. Spence, Yore, and Williams (1999) examined the effects that explicit instruction of science reading strategies had on seventh grade students' metacognition and comprehension. The study was done over a period of 22 weeks and yielded strong support for this type of instruction. Significant improvements were found on post-tests of metacognition and comprehension. This showed that through explicit science reading strategy instruction, reading comprehension and metacognition can be improved. Strategies that were found to improve comprehension and metacognition in this study were instruction in textbook organization, accessing prior knowledge, setting a purpose for reading, looking back for information, identifying main idea, and summarizing. These strategies can be applied to math class. Students were engaged in inquiry activities throughout the classes. They were arranged in groups and used discussion, Read-Aloud, and Think-Aloud for strategy instruction. Group work, Think-Aloud, Read-Aloud, and inquiry activities were also a part of math class.

It is important to activate students' prior knowledge when approaching new text. Barton, Heidema, and Jordan (2002) suggested using Anticipation Guides to activate and challenge students' prior knowledge and drive further prereading instruction. They also stressed the importance of understanding vocabulary needed to grasp the concepts involved in reading. The use of a Semantic Feature Analysis helps students with a visual representation of how terms are interrelated.

The during-reading strategy of paired Read-Aloud can be used to support students' reading of content text, according to Harris and Storr (2005). Students worked in pairs taking turns reading a passage of text. They were then required to restate what they read. Students may have also rephrased what the partner read aloud. Lastly, the students shared in a whole-group setting the most important concepts of the reading. This strategy benefited students and teachers beyond the understanding of science text. Student behaviors improved as their science literacy improved. Heselden and Staples (2002) suggested using active reading strategies to support students' comprehension of science text. They suggested the use of cloze and sequencing activities to help students become actively engaged with the text. These active reading strategies are an important part of content instruction.

Literature in Mathematics

Many benefits have resulted from the use of literature in mathematics class. There have been noted improvements in content reading strategies, understanding of mathematical concepts, and improved problem solving skills.

Moyer (2000) described the importance of the use of literature in math class, especially in elementary grades. Children's literature helps students in elementary grades to bring their expressive language skills to math thinking. She also found that the connections that students make to real-life situations through math literature are important to their understanding of math concepts. In 2001, Moyer found similar importance in the use of connections to real-life. She used a math story that integrated the concepts of perimeter and area. The students found and explained both concepts within the context of the story. Moyer concluded, "If we want children to be successful in problem solving, we must give them many opportunities to solve problems in meaningful contexts" (p. 59). Using children's literature is one way to make the context meaningful to students.

Additional benefits of using literature in math class is increasing student interest and decreasing math anxiety. Zambo (2005) discussed the use of the book, *A Grain of Rice*, by Helena Pittman. He described a

variety of math activities that emerge during the reading of the book. Zambo (2005) found that when students were explaining their reasoning, assessments could take place through observation of students. Jenner (2002) found, similarly the importance of students thinking mathematically during the reading of children's literature. The students she observed were able to process math concepts presented in the literature in the familiar setting of a story.

Summary

The research strongly supports explicit instruction in content area reading strategies. There are many strategies described including activating prior knowledge, understanding text format, vocabulary instruction, and talking about text. These strategies can be instructed in many ways. The instruction can be used to meet the diverse needs of students. The benefits to all students include increased metacognitive awareness, improved comprehension, and independence with reading text.

METHODOLOGY

Introduction

In my plan to investigate the explicit instruction of comprehension strategies in my math class, I implemented content reading strategies in math. I began with activities to activate prior knowledge. This was followed by vocabulary development activities. The students were instructed in text features and purpose setting. They then participated in activities to monitor comprehension. The students were engaged in discussions of text throughout the investigation.

Setting

I teach in a middle- to upper-middle-class suburban school district in northeastern Pennsylvania. The school is a kindergarten through fifth grade school with approximately 300 students. There are AM and PM sections of kindergarten and two classrooms at each grade level. The school also has a learning support classroom and life skills classroom. There are remedial support aides that follow Title-1 programs, although the school district does not qualify for Title-1 funds. The remedial program is funded by the district. There is also a part-time gifted teacher. There are specialty area teachers for health/wellness/fitness, music, library, and art, each with its own classrooms. There is one principal for the building.

The school building was rebuilt seven years ago into a more modern facility. Each classroom has a sink and wall of closets. There are six computers and one wall-mounted television per classroom. The classrooms also have a mounted screen for use with an overhead or video projector. There is a wall mounted dry erase board and chalkboard. There is technological equipment available for use in the school. The school has two digital cameras, a digital video camera, and five interactive smart boards. Each grade level has a video projector, VCR, and DVD player.

I use the dry erase board as the main area for instruction in my classroom. On the opposite wall, the computers are lined against the chalk board. The student desks in my classroom are arranged in cooperative groups of five to six desks. There is an area with two tables for small group instruction. My teacher desk is in a corner of the classroom near a window. A file cabinet sits near the door for materials. There is also counter space under the windows for materials the students may need.

Participants

The participants are fourth grade students. My math class is a group of 22 low-ability students from the two 4th grade classrooms with 8 girls and 14 boys. Six of the students receive remedial support services. The remedial aide supports the students in the classroom for 45 minutes, four times per week. In the class there are two learning support students

who receive support from an aide during class. Three of the students receive ESL services.

Procedures

The first step in my research was to obtain written consent from my building principal. I informed her of my study with a letter and obtained her signature agreeing to consent (see Appendix A). During the summer, our principal was transferred and we hired a new principal for our building. I also informed him of my study and obtained consent (see Appendix B).

I then submitted an application of proposal of my research to the Human Subjects Internal Review Board (HSIRB) of Moravian College. The board reviewed my proposal to ensure the safety and ethical treatment of the human subjects involved. The HSIRB approved the proposal prior to the start of the research (see Appendix C).

Following HSIRB approval, I sent informed consent forms to the parents of the students involved in the study. The parents signed and returned the consent forms allowing the students to participate (see Appendix D).

I introduced the study to the students upon receiving parental consent. I began by telling the students that I am a teacher and a student. I explained that I will be conducting a project using activities we will do in math class during the next few months. I elaborated on the activities and

the importance of these activities. The students were then asked to complete a Math Autobiography, a class survey that asked the students about their prior math experiences and their use of the math book (see Appendix E).

I began my study by distributing math folders to students. The folders would hold papers that the students could use as reference materials, as well as worksheets and notes. I then started instructing the students in elements of content reading. These were listed on a handout that the students put in their math folders (see Appendix F). We also reviewed problem solving steps and strategies found in the math book (see Resources). The students also put a vocabulary graphic organizer in their folders for defining new vocabulary for each chapter (see Appendix G).

At the beginning of each new math chapter, the students completed a Check What You Know page to activate prior knowledge (see Resources). These pages included vocabulary and prerequisite skills for the chapter. They also had vocabulary instruction. The vocabulary words were recorded on a graphic organizer with a definition and example or visual representation for each. The content reading strategies that were instructed for the lessons varied depending on the content being instructed.

An integral part of the study was student collaboration. The students were often engaged in discussions of material with partners or small groups. The groups were originally assigned by mixing students randomly from the two classrooms. The groups changed throughout the study as needed. While the students were working collaboratively, I recorded observations in a two-column journal (see Appendix H). In the first column, I recorded observations of students using the strategies and the discourse between students. I then reflected on these observations in the second column.

Following lesson instruction, practice workbook pages were often assigned for homework (see Resources). These pages usually served as formative assessments. Some were collected for grades. Review workbook pages were assigned as needed (see Resources). These pages reviewed the concepts taught from each lesson. The lesson is broken down into simple steps on these pages. These also provide formative assessment information. Upon completion of each chapter, students often took a quiz correlating with the PSSA assessment anchors for fourth grade from that chapter (see Appendix I). As a unit was completed, the students took the multiple-choice test from the math series (see Resources). The activities, including content reading strategies, for each chapter are listed below.

Unit 1: Understanding Numbers and Operations

This unit included these topics: place value, number sense, compare numbers, order numbers, add greater numbers, and subtract greater numbers.

Chapter 1: Interactive Reading Guide (see Appendix J) followed by a Chapter 1 test

- The Interactive Reading Guide is a worksheet that shows students the activities for the lesson that is being presented. The way in which the students will complete the activities is also shown. This includes whole-group instruction, paired collaboration, small group collaboration, and independent work. This guide allows students to work at different paces and guides them to work collaboratively.

Chapter 2: Sequencing Text (see Appendix K) and Group Retelling (see Appendix L) followed by Chapter 2 test

- Sequencing Text is a strategy where students can interact with sections of the text. They read the text, cut apart prepared sentences from the text, then put them in the order that they occur in the text.

- On a Group Retelling sheet there are problems from the lesson. The students complete the problems and retell how the problems were completed in groups.

Chapter 3: Paired Retelling (see Appendix M), Problem Solving K-W-L (see Appendix N), and Chapter 3 quiz

- The Paired Retelling is similar to a Group Retelling sheet. Students talk through problems with a partner rather than in groups.
- The K-W-L is a chart used for problem solving. It allows students to read and write about a problem. They write what they know in the K column, the question to be answered in the W column, and then write the problem solving process in the L column.

Chapter 4: Interactive Reading Guide, Paired Retelling, Group Retelling, K-W-L, Chapter 4 test, and Semantic Feature Analysis (see Appendix O)

- A Semantic Feature Analysis will assess students' understanding of vocabulary. They complete the chart by marking the features that match each item that is presented.

Unit 2: Data, Graphing, and Time

This unit included these topics: collect data, organize data, analyze data, graph data, and understand time. The students were responsible for learning bar, line, and pictographs, as well as tables and charts.

Chapter 5: Group Retelling and Chapter 5 quiz

Chapter 6: Venn diagram (see Appendix P) and graph quiz

- A Venn diagram is used to compare and contrast topics. This was used to compare and contrast three types of graphs and their features.

Chapter 7: Written Retelling worksheet (see Appendix Q) and Unit 2 test

- The Written Retelling worksheet is similar to the Paired or Group Retelling worksheet. It includes problems from the lesson for students to complete. It also includes space for students to write an explanation of how problems were completed.

A Group Interaction Interview was conducted upon the completion of Unit 2 (see Appendix R).

- Student collaboration was a large part of the study. The Group Interaction Interview was designed to understand

how students felt about groupings and what they had learned from each other.

Unit 3: Multiplication and Division Facts

This unit included practice and use of multiplication and division facts.

Chapter 8: Math Literature, Written Retelling worksheet, K-W-L, and Chapter 8 quiz

- Math Literature involved using trade books to introduce or further examine math concepts. For example, *The Doorbell Rang*, by Pat Hutchins, aided in the introduction of division.

Chapter 9: Say Something Grid (see Appendix S), Reaction Guide (see Appendix T), and Unit 3 test

- The Say Something Grid allowed students to react to sections of the text at designated stop points. They wrote one comment on the grid in any of the four sections that are labeled for each type of reaction: question, comment, connection, or “wow.” This helped students monitor their understanding and guided the teacher to support the students.
- The Reaction Guide helped students draw conclusions from a data source. The students looked at a table and agreed

or disagreed with the statements presented on the Reaction Guide. Then they supported their statements with evidence read and interpreted from the data source.

Unit 4: Multiply by 1-Digit Numbers

This unit included these concepts: multiplying by 1-digit numbers and understanding multiplication.

Chapter 10: Say Something Grid, Problem Solving K-W-L, Math Literature, and Chapter 10 test

Chapter 11: Paired Retelling and Unit 4 test

The Math Autobiography II (see Appendix U) was completed by the students following the Unit 4 test.

Data Collection

I was able to triangulate my data collection through recording participant observations, conducting surveys and interviews, and collecting student work.

I recorded participant observations on a daily basis throughout the study. I observed students' participation in the lessons and their collaboration with partners and group members. The observations were recorded in the left column. This often included student responses to questions and discourse with group members. In the other column I recorded my own reflections on the observations. This might have

included what I thought about the class participation or understanding of the lesson. I also included some insights and direction for future lessons.

The first survey I collected was the Math Autobiography. I was able to get information on student's prior math experiences, their own perceptions of their strengths and weaknesses in math, and information on their awareness of elements of content reading. I gave this same survey at the end of the study and asked students to answer it regarding math this school year. I interviewed individual students following the second Math Autobiography to get further information regarding specific answers on their surveys. I conducted interviews of group members individually. These interviews were aimed at collecting information on group dynamics and learning. I asked students a series of questions regarding their interactions with group members.

The final pieces of data I collected were student work. I collected the Check What You Know page for each chapter along with chapter quizzes and tests. In addition to these, I collected work that was directly related to a content reading strategy. I collected paired and group retelling worksheets, a Semantic Feature Analysis, written retelling worksheets, K-W-L charts, Say Something grids, a Reaction Guide, and worksheets from math literature activities.

TRUSTWORTHINESS STATEMENT

There are many ways I worked to ensure trustworthiness in my research. I ensured participant confidentiality through various measures. I was an objective researcher by not predicting the outcomes of the study and considering multiple points of view. I was self-reflective and examined my own biases. My participants were involved throughout the process with participant checks being conducted periodically. I gathered and analyzed various types of data, including student work, interviews, and survey data, to get a layered picture of my students.

I began my study after receiving consent from my building principal and from the parents of the participants. Holly, Arhar, and Kasten (2005) also advise discussing the study with students, in terms they can understand, and answer questions or address concerns they may have. I assured the students that participation in the study is not mandatory, and I reminded them that they may withdraw at any time without penalty. I let them know that they would participate in the learning, regardless of their participation in the study.

Anonymity was maintained through the use of pseudonyms, as suggested by Holly, Arhar, and Kasten (2005). I assured students and parents that names and work would be kept anonymous, as well as the names of teachers, other staff, and school information. Any information

that may reveal a student's identity was altered to protect anonymity. No names were included on work samples or in any reports of my study. I kept my log locked in a file cabinet to further ensure confidentiality.

I was an objective researcher in many ways. I did not predict the outcome of my study, only observed for any changes that occurred. I recorded observations of students daily in my log. These observations were examined and coded. Ely, Anzul, Friedman, Garner, and Steinmetz (1991) outlined seven steps to data analysis. These include rereading your log, coding, creating an index, and organizing codes into bins. I was then able to write theme statements from these bins. This process helped me remain open to many different findings.

I was sure to be as comprehensive as possible by observing all of the groups of students in my study. I rotated through the groups and tried to get to each group at least once a week. The observations in my log helped me to pay greater attention to what was happening in my classroom, which also helped me to remain objective.

Along with each observation, I added a separate column of comments and self-reflection. Keeping the observations separate from the reflections ensured that I was just reporting on what has actually happened. This also helped me to remain objective. Through self-reflection I was able to monitor myself and my biases.

I came into this study with some biases. I had some preconceptions formed about these students since I taught some of them in first grade. Whether these biases are positive or negative, my awareness and acknowledgment of them is important. Ely, Vinz, Downing, and Anzul (1997) agree that by recognizing the biases in writing you are able to monitor them throughout the study and address them as needed.

Another bias I have is in my attitude toward math. I have always had a negative attitude toward math. Math was a subject that posed great difficulty for me. I believed that my students share this negative attitude. I needed to keep in mind that some of my students really like math. They may have participated and thrived in class because of their love of math.

My research support group also helped me to be objective through our discussions and examination of each other's work. I was able to discuss observations and reflections with them and ask them to check for biases. MacLean and Mohr (1999) state, "The group challenges each other's assumptions, proposes alternative interpretations, offers suggestions about research methodology, responds to drafts, and often lend personal as well as professional support" (p. 21). They go on to say that the groups also aid in the validity of the data through additional analysis and interpretation.

My participants were involved throughout the process. Holly, Arhar, and Kasten (2005) and Bogdan and Bilken (1998) both advised that participants be involved in the research process. I surveyed and interviewed students periodically. I assured the students that they could be honest in the interview without hurting my feelings or having negative consequences. This was supported with the level of trust that was achieved with the students. I interviewed the students in a secluded area so they could answer freely and have privacy. Holly, Arhar, and Kasten (2005) stated, “Building a classroom environment based on respect is the first ingredient of ensuring confidentiality” (p. 177). I wanted to assure students that their interview and survey information would not be used to lower their grades.

I conducted participant checks by asking students to read and comment on pieces I wrote for my final paper that involved them and their work. This gave students the opportunity to agree or disagree with what I wrote about them. I was able to paint a more accurate picture of the students through conducting participant checks. I also assured students that they could withdraw without penalty at any time during the study.

I collected and analyzed student work, along with the interview and survey data. This provided me with data from many different angles and helped to create a layered picture of the students. Hubbard and Power

(2003) define this as triangulation, “The use of multiple and different sources, methods, investigators, or theories [at least three] to confirm findings” (p. 120). Collecting and analyzing various types of data also helped me to see a broad picture of what was happening in my classroom.

MY STORY

The first days of school always hold mixed feelings. It is exciting to meet the new group of students. It is challenging getting to know them during the first few days and weeks. It can also be difficult to get back into the routine at the end of the summer. The students are excited to see their friends again. I imagine that the students are anticipating meeting the teacher, wondering what he or she will be like. We all wonder what the year will bring for us.

At the start of this school year, I was feeling more excited and a bit uneasy about what was ahead. I was about to begin a project that would change me as a teacher and a person. It would be a school year that I would never forget.

I looked around the room on the first Friday of this school year. The students in front of me were wide-eyed and smiling. They looked excited for math to begin. I wondered if I was as excited as they were. Most of these students would spend the year with me in math class. This was only my second year teaching 4th grade and the challenges that I faced in math last year were still fresh in my mind. I reminded myself that this was a new year and new students.

My teaching partner and I had worked carefully to place these students in the most appropriate classroom for math. We administered a

4th grade inventory test, checked their records, and spoke with the 3rd grade teachers. We explained to our students that they would be starting on different levels. We were grouping them according to what they already know in math and what they need to learn. I had the group that was starting on a lower level. They had scored lower on the inventory test and had less knowledge of previous math concepts.

I was ready to begin my study. I had put many hours of preparation into this study. I had informed my principal at the end of last school year and obtained written consent from her. Over the summer I submitted my proposal to the HSIRB and was approved for my study.

I introduced the study during this first day of math. I told them they were the luckiest fourth graders to a part of my research study. They were smiling at each other and looking around. Some of them had their hands in the air with questions. I continued explaining that I would be studying my teaching to make me a better teacher. I also said that I would need the consent of their parents in order to include their work and comments in my final project. I told them that I would not use any of their real names in my paper and that they would be able to withdraw at any time. I explained that whether or not their parents gave consent, they would still participate in all of the activities. Lastly, I said that they could not be penalized for not

participating, meaning that I could not give them a bad grade for not being a participant.

I sent consent forms home to parents and received all of them back by Monday that all of the students were able to participate. I was able to begin the study on the first day of math class.

Our Math Histories

New learning in school subjects is based on previous learning. Math always builds upon previous skills. The curriculum I teach is no exception. The students are expected to have mastered certain skills to be able to learn new skills. I often had difficulty in math because I had not mastered previous skills. My math history had a negative impact on my math performance. Not only did I have difficulties in math, but my attitude about math was very negative because of these experiences. I was curious about my students' math histories. I wondered if their experiences were similar to my own. I wanted to find out about their math histories.

The first activity we completed was a Math Autobiography. Vygotsky stated, "Any learning a child encounters in school always has a previous history" (1978, p. 84). He believed that children have math experiences prior to attending school that vary from one student to the next. Through these experiences, the student develops new skills that will later influence the skills they learn in school.

The Math Autobiography (see Appendix E) was a type of survey with statements for the students to complete. The statements included information regarding their prior math experiences, how they learn best, and what they are good at in math. It also included statements regarding their reading of math texts and problem solving.

I noticed that some of the students were not writing anything on their papers. I wondered why they were having so much difficulty. I read the first statement aloud and gave my own example of how I would complete the statement. I then did that for the rest of the statements. I asked them to be honest, restating that this would not be graded. I reminded them that I just wanted more information on how they learn math and how they honestly feel about math. The following pastiche shows some of the results (see Figure 1).

MATH HISTORY

Math makes me feel...

good because it is really fun!

happy because it is fun sometimes.

good

worried because I might not understand.

ok

good

kind of nervous because its hard.

ready and very happy.

good

ok

nervous

good because it is my favorite part of the day

good

Blank

confused

excited because it is simple.

all emotions

good

mad because it is hard

cool!

good

Figure 1. Pastiche using student responses from Math Autobiography.

Although many of these students had been in the lower math group in 3rd grade, most of them still felt good about math. Many of the students felt they learned best by listening to the teacher. I had given this response as an example, and I wonder if this influenced some of the responses. Kevin included that he learns math by going over it with his parents. The majority of the students felt that word problems were hard for various reasons. Peter felt that the problems were hard because he is not good at them. Diane answered that she does not understand math and that is why problem solving is difficult for her.

One student, Mark, had particularly stood out from the first day of math. Mark was a learning support student who had a comment for much of what I said to the class. He was bigger than most of the other kids, which also made him stand out. I thought from the moment I met Mark that he would be a challenge to teach this year.

Mark had difficulty completing the Math Autobiography. He had difficulty with fine motor skills and was not happy about having to write responses during the first math class. His responses to the survey were short and to the point. He wrote that math makes him feel confused, and that second grade was his most positive math experience, “because it was fun.” His penmanship looked large and labored on the worksheet, and

many words were misspelled. Part 1 of Mark's layered story shows how he began math this year (see Figure 2).

Mark's Story - Part 1

Mark

I can't believe she is making us write on the first day of math class. This ain't writing class, it's math. She wants to know how I feel about math. I don't know. I guess I'll say that it makes me feel confused. Why does she care about how we feel about math? We have to be here anyway. I don't know why teachers give us papers without lines. I can't write without lines. I guess I'll draw my own in.

Me

Mark really looks like he is struggling with this writing. I didn't realize that writing was so difficult for him. Mark usually has so much to say in math class, you would think this would be easy for him. I think Mark is going to challenge me this year. He seems like the type of kid who will test the limits to see how far he can get. I'll just have to be consistent and fair.

Figure 2. Part 1 of Mark's layered story.

My math history was an important part of my math experiences and I wanted to show my students that I find their histories important as well. Freire (2006) also wrote about history as an important element of problem-posing education. He stated, "Problem-posing theory and practice take the

people's historicity as their starting point" (Freire, 2006, p. 84). If I take into account that my students are starting with different backgrounds and skills, it might make my teaching easier. I could provide opportunities for students that will build on what they already know.

Upon completion of the Math Autobiography, the students completed a Check What You Know page (see Resources) for Chapter 1. This also provided me with historical information on my students. I was able to see what they remembered from previous years on the concepts of place value and number sense. Most of the students solved the problems correctly, which included: writing numbers from word form to standard form and identifying the value of an underlined digit in a number. The greatest difficulty came with matching vocabulary words to complete a sentence. All of the students except two had at least one of the four matched incorrectly. The majority of students had two to four wrong.

Beginning Strategy Implementation

Vocabulary Instruction

One of the most important elements in reading content text is being able to understand the vocabulary used in the text. I implemented a Vocabulary Graphic Organizer (see Appendix G) for students to define and draw an example of each vocabulary word we encounter in our math text. Our first lesson included using the graphic organizer for the word,

benchmark number. I wrote the word, definition, and example on the board. I then asked the students to copy this into their own organizers. I found this to take longer than I had thought. It was difficult for some of the students to write in the small grid. We discussed the vocabulary word and examples of problems using this vocabulary. We also read in the text about the vocabulary word and used it in examples. When the students were working collaboratively, I observed one group using an alternate word, layers, to describe the benchmark. Even though I had emphasized the word, *benchmark numbers*, in the beginning of class, the students did not use it in their discussions.

In the beginning of the next class we reviewed the vocabulary from the previous day and copied new vocabulary into the graphic organizer. The students were familiar with the process, so the copying went much more smoothly on the second day. The words were more familiar to them also. This may have helped in their use of the words and ease in copying the words and definitions.

Interactive Reading Guide

The first new content reading strategy I introduced was an Interactive Reading Guide (see Appendix J). This guide gives students a visual representation of what will be completed in the lesson and how it will be completed. This might include whole-group instruction, paired work,

small group work, and independent work. It was also designed to allow groups and pairs of students to work at their own pace. As they successfully completed each step on the guide, they could move to the next. I thought the guide would be useful for this lesson because it was content for which the students had exhibited strong prior knowledge.

I explained the guide and how it is used. Then we followed the steps for the lesson. The first step was a whole group review of vocabulary and introduction of new vocabulary. The next step was to read and discuss a page in the math book as a whole group. Step 3 was to complete book problems in pairs. The students were supposed to be answering questions about values of digits up to hundred thousands.

At this point we began to encounter difficulty. Some of the students were having difficulty with the ten thousands and hundred thousands places. I had not seen this in the whole-group lesson or on the Check What You Know page. The students were not able to continue in their pairs because some of them were having so much difficulty with the concept. I reviewed with the students and continued with the lesson.

The difficulties continued as the lesson went on. The students were having problems with the millions place, since some of them were not familiar with lower places. I was getting frustrated and recognized that I needed to do something differently. I had to stop following the guide and

continue with whole-group instruction and review. The class ended with me feeling frustrated and the students not having a great experience with the Interactive Reading Guide. They were not using the examples and instructions in their math books to help them solve the problems. Some of them were more confused on place value than when they started. I felt like my first new strategy had completely failed.

Place Value Graphic Organizer

The next day, I was armed with new, focused objectives and confidence I had not had before. I had spent the previous evening matching the PSSA Assessment Anchors and Eligible Content for fourth grade with our math book for the district elementary curriculum director. The goal of this was to be able to fit all necessary lessons for the PSSA in before March. I realized that many of the lessons I had planned on teaching, including the lesson on place value to millions, were not eligible content for fourth grade. I had a clearer focus once I was finished with matching the lessons. This made my teaching more focused. I felt like I was starting over.

I stated the objectives to the students. I also changed the student groups. I had started the year with math groups that were merely a random mix of students from both classes. The new groups were organized by the prior knowledge of place value displayed on the Check

What You Know page. I grouped the students heterogeneously, placing students with little prior knowledge with students who had a good understanding of place value.

I decided to reteach the previous place value lesson that the students had difficulty learning. After stating the objectives to the students, I started with reviewing and introducing vocabulary. The students, with a common goal to work towards, were more engaged and participated in the lesson. I created a place value vocabulary graphic organizer to support the students who needed extra help with place value (see Appendix V). I had all of the students complete the graphic organizer, and it was taped into their math folders. I asked students to refer to this organizer when they needed help identifying a place. After a whole-group lesson, the students completed book problems in their cooperative groups.

The students were collaborating in their groups much more successfully. The students who needed support had the graphic organizer available, as well as students with prior knowledge to work alongside. The students were more engaged than the previous lesson and much more successful with the book problems.

Sequencing Text

During the next lesson, I implemented a new strategy: Sequencing Text. Sequencing Text is a strategy where students were able to interact

with sections of the text. First, the students read the page in the text on comparing and ordering numbers to the hundred thousands. Next, I gave each group a Sequencing Text Worksheet (see Appendix K). The worksheet contained three boxes of text that corresponded directly with the text in the book. Students cut apart the text boxes on the worksheet. Then they put them in order according to the steps written in the text. Last, they reread the text boxes to emphasize the importance of these three steps in comparing and ordering numbers.

The students were enthusiastic about trying the Sequencing Text strategy. They used scissors to cut apart pre-printed worksheets. This highlighted the important parts of the text for students so the text became more accessible to them. The students were showing enthusiasm during this lesson. The group members were engaged in hands-on learning and using the text.

As the groups finished the Sequencing Text activity, the students in the groups worked together to complete problems that I had written on the board involving comparing and ordering numbers. The first set of problems on the board asked the students to compare numbers in the thousands place. They had to copy the two numbers from the board onto a small whiteboard they had at their table. Then the students had to work together to fill in the greater than, less than, or equal to sign that

completed the problem correctly. I asked each group to hold the board up when they completed each problem so I could check their work. I observed one group working collaboratively to complete the problems from the board.

Comparing Numbers: A Dramatization

The Characters

The three characters are Joseph, Mark, and Tom. Joseph is a talkative student who enjoys working with other students. He is often talking during independent work time in class. Joseph is a generally happy student and tries to follow the rules. Mark is a learning support student who prefers to work alone. Mark had shown defiance from the first day of math class and had been difficult to get involved from the beginning. I never knew which Mark would arrive at math each day. Sometimes we have a cooperative Mark that participates and answers questions. Other times there is a quiet Mark who sits in his seat and puts his head down. There is also a defiant Mark who breaks every rule he comes across. Tom is another learning support student who also prefers to work alone. He has a host of learning difficulties, motor skill difficulties, and an attention difficulty. Tom usually does not participate in lessons and does not complete his homework at home.

I had observed this group being off-task during many class periods. They were often a very talkative group, but not talking about math concepts. The learning support aide that worked with Mark and Tom spent most of her time keeping them on-task rather than assisting them with concepts. She had been working with another learning support student during this activity.

The Scene

Joseph, Mark, and Tom were working cooperatively on a problem from the board. The three boys had one small whiteboard and a marker to complete the problem. They had a group of four desks, with Mark and Tom next to each other on one side, and Joseph next to Logan, who was absent, and across from Mark. Joseph was out of his seat standing next to Tom's desk. Tom was the recorder. He was having difficulty with the small whiteboard and marker. He wanted the numbers to be perfect, so he was writing and rewriting the numbers. The problem on the board was written as follows:

9,036 O 9,125. Compare using <, >, or =.

As I approached the group, Mark was facing away from TOM and Joseph. He was drawing on the front of his math folder. He noticed me watching the group and tried to look like he was participating along with Joseph and Tom.

The Conversation

Mark: (to Tom) Which one is bigger: 4,036 or 9,125? (He reads the numbers Tom has just written. Then he continues his drawing.)

Tom: (Erasing part of a number and rewriting it again) What? The first number is 9,036.

Joseph: (to Tom) Very Good! Now, which one is bigger, 0 or 1?

Mark: (Interrupts) What? That one is 9 and that is 4. We should be comparing the thousands place!

Tom: (Correcting Mark) They are both 9.

Mark: Oh. Well, then we need to go to the hundreds place. One is greater than 0, so we need to use this sign. (He takes the marker and draws the less than between the two numbers.)

Joseph: (to Mark) That's right! 9,036 is less than 9,125.

The Analysis

There are many reasons why I appreciated this group's cooperation on completing the problem. They were on-task during this activity and working well together. Even though Mark was not attending to the group at first, he did get involved without me having to verbally intervene. Another reason I enjoyed this exchange was the peer praise that Joseph was giving to the other group members. I had not heard any students praising each other before and liked the way Joseph was keeping the group going

through his use of praise. The boys were also using math vocabulary words by naming the places they were comparing. Although Mark did not use the word for the “less than” sign, he did use the correct name for the place the numbers were in that he was comparing. Lastly, I especially liked the way Mark had verbalized his answer. He explained, in words, how he came to that answer. I enjoyed watching his interaction with the group and his explanation of the answer to the problem.

Importance of Collaboration and Talk

Not all students were going to benefit from each of the strategies implemented in the study. However, it was my goal to expose them to many different strategies and let them begin to recognize what would work for them individually. I wanted to provide the students with plenty of opportunities in class to use math vocabulary in explanations and conversations about problems.

This idea is supported by readings in Dowdy (2002). In one case, Dowdy described her own experiences as a child. She had to learn to speak a different language than her native language and felt conflicted when using the new language. She did not feel that she was able to properly express herself in the new language. Dowdy stated, “The issue is about having enough opportunity to practice that language in ‘legitimate’

communications" (pp. 12-13). It is important for people to practice a new language in an authentic way and in a safe, judgment free environment.

Math has its own language, including vocabulary and rules. Opportunities must be provided for student to mix this language with their own spoken language for them to be comfortable with the language of math. I wanted to provide students many opportunities to speak math language with each other before they were judged on their ability to write it in an explanation of problem solving. The following two strategies are examples of ways I incorporated collaboration and talk into my classroom.

Group Retelling

Group Retelling was a strategy to scaffold the explanation of a problem's solution. The students work cooperatively in groups to give the best explanation of the solution they got to the problem. I explained to the students how this Group Retelling sheet would work (see Appendix L). They would read the problem that involved completing a table and complete the table cooperatively with their group members. Then they would have to explain the steps to each other that they took to complete the table when they were done. I told the students that I would be around to listen to the group explanations. I would hold each group member accountable for part of the explanation by asking questions.

One group had an emerging leader. Carly was recording the group's work on the worksheet and asking the group questions on how they wanted to complete the table. She waited for their answers and then wrote. One of the other group members, Diane, asked if she could help write some of the answers. Carly told her to be sure she wrote them neatly. The group was able to explain their answer in sequence. The students used proper math vocabulary in their explanation.

Mark, Tom, Joseph, and Logan's group was less successful. They had their table completed, but when asked to explain it, they were not able to tell me how they got the answers. Two group members, Mark and Tom, accused the other two members, Logan and Joseph, of doing all of the work. Logan and Joseph accused Tom and Mark of "just talking" and not working. Joseph finally told me that they put the data in order from greatest to least. Although the group did not work well together, at least Joseph was able to somewhat explain the answer and use some of the math vocabulary.

This was interesting because I had observed such a positive dialogue with this group in a previous lesson. During this day's lesson, the students were talking socially, and some members were getting frustrated with the others. I had noted before that this group was very social in their talk. I still held out hope for them to be able to work well together.

Paired Retelling

The next new strategy I introduced was paired retelling (see Appendix M). This was similar to the group retelling worksheet. The students were given a worksheet with six problems involving subtracting across zeros. They were instructed to subtract and estimate to check. I also told them to explain each step to their partner as it was completed. I had observed two pairs of students working on this activity.

The first pair of students was William and Kevin. William was new to our school this year. He showed potential from his first day in math. William answered questions thoroughly and with great thought. He was often willing to participate and take risks when other students would not. Although William performed well in class, he sometimes did not complete homework and he often struggled on assessments. Kevin, also a new student this year, was just exited from the ESL program. I had observed him not paying attention to classroom lessons, and he seemed to not follow the instruction on many occasions. Although he experienced difficulties in class, Kevin's homework was always completed correctly. Kevin had commented on his Math Autobiography that he learns best from practicing at home with his parents. I could tell that this was true from his lack of performance in class and great performance on homework. I had

wondered if a language difficulty was causing Kevin to be challenged in math.

Kevin was completing the first 3 problems without any verbalization of the steps. William was watching him closely and reminding him of what he needed to do if he missed a step. He completed all of the problems correctly with some assistance from William, but he did not verbalize any of the steps. I did not intervene with Kevin or challenge him to verbalize the steps. I thought that if he was not comfortable to verbalize the steps yet, then I would not make him do this. William, on the other hand, verbalized each step out loud to Kevin as he completed his problems. He had given Kevin a good example to listen to. Kevin watched as William completed the problems, never having the opportunity to correct him, as he completed them all correctly.

The second pair of students I observed was Christopher and Anthony. These boys had some difficulties working in a group together earlier in the study. Christopher had fallen behind in the task they were completing while Anthony led the group through the task very quickly. Christopher had expressed concern with this, stating that “[the rest of the group was] working quickly and not paying attention to what they were doing.” Christopher was correct, since the rest of the group had some mistakes on this earlier task. I had intervened with this group since

Christopher was so upset with the group and had actually cried. I spoke with them about my expectations at that point, reminding them that we are all new to working together and had to listen to each other more. I told them that we would work better together when we got to know each other better. I was keeping an eye on this group since then because of the conflict within the group. During the paired retelling, there was not verbal conflict between the students, but the tension between them was obvious.

Both students had successfully completed the problems and explained, in words, each step very carefully. Anthony seemed to benefit from verbalizing his work. He had performed much better on in-class tasks than on tests. I believed that this was because of his verbalizing the steps of the problem in class, as opposed to working quietly on the test. Christopher, although it seemed that he was not paying attention in class sometimes, did well on tests. It appeared to me that he would rather work alone, but wanted me to see that he was capable of doing the work on this task without Anthony having to tell him what to do.

Continued Strategy Instruction

Problem Solving K-W-L

Problem Solving K-W-L was one of the strategies I was most excited about introducing to my students this year. I had used K-W-L charts in reading and science in previous years. This was the first time I

would use one in math class, but it really made sense to me. I always had difficulty with problem solving tasks in math. I never understood what the problem was asking and what information I was supposed to use to solve the problem. Then to have to explain how I solved the problem was difficult, because I did not know how to solve the problem. When I came across this idea in my research I was very excited. I finally had a strategy that made sense to me and would give me an organized way to solve problems.

When I introduced the strategy to the students, I guided them through a few problems using the Problem Solving K-W-L chart (see Appendix N). I explained how each column was used and worked through the first problem for the students. To complete the second problem, I had the students write along with me on their own chart. The first two columns went really well. I had volunteers participating in answering questions I had asked about the problem. The students were responding to the text by identifying information from the problem that was used to complete the problem. They were able to solve the computation part of the problem. I had been very excited about how this was going. They seemed to be getting it. Then it was time for the explanation of how we solved the problem. Suddenly the students were not participating. I started writing an explanation on the board for them to copy. Most were dutifully copying

from the board, but some were complaining while doing this. I really thought that the K-W-L chart would make this step easier, but it did not.

Although this lesson did not meet my original expectations, I was not ready to give up on the K-W-L chart. This lesson gave me some new ideas for implementing the chart. I would have to scaffold students' written explanations, possibly by starting with a basic explanation and then moving to a more detailed one. I also had to recognize the successes the students experienced with the lesson. I had given them problems to practice with in class following the use of the K-W-L chart. They did not use the chart for these problems or for their homework, but they did do well on the tasks. The students were very successful in completing problems independently without having to give an explanation.

K-W-L Second Try

A few lessons later, I tried the K-W-L chart again. The lesson in the math book was *Make a Model* for problem solving. I was worried about how the students would respond to the K-W-L chart this time since it was difficult last time. I wanted to give it another try, though, since I felt so strongly about it.

We began by working as a whole class to solve the first problem. I read the problem for the students and asked for volunteers to tell me what to write in the K column. The students answered correctly and I wrote their

responses on the board. They copied this information into their own K-W-L charts. I asked for volunteers to tell me what to write in the W column. A student identified the correct question and we wrote it in our W columns. The last step was to solve the problem. I showed the students an example of a model from the math book and encouraged them to solve it by making their own model. I then instructed the students to solve it on their own.

They sat silently for 20 seconds. I said, “Go ahead. Get started working on your own.” Most of the students started working on solving the problem. Some of them drew a model. Some students wrote equations to solve it. The important thing was that they were trying on their own. A few students wrote the answer in a sentence. One or two students also began to write an explanation of the answer.

Mark was having difficulty at first. He completed the first two columns at the insistence of the aide. He did, however, complete the last column on his own. He was able to complete it correctly by simply adding and subtracting. He did not make a model. Part two of Mark’s story is shown in Figure 3. It tells the story of this lesson from two perspectives.

Mark's Story - Part 2

Mark

This again, ugh! Last time she wrote so much on the board I thought I'd never finish copying it. She gives us such a little space to write in. I'll just sit here again and not copy it. I know the aide will bug me to get writing, but it's hard. Nobody understands how hard it is.

Now she wants us to draw a picture to solve the problem. It makes more sense to me to just add and subtract. Besides, I can't draw that picture. I don't have enough room. I'm just going to add and subtract; now that I know how to do.

Me

I know that Mark had trouble with the writing on the K-W-L chart last time. I hope he doesn't just sit there again. I know he has difficulty writing, but he is capable of doing it. I don't want to have to nag him to do another thing.

What an interesting strategy. Mark completed the problem correctly by adding and subtracting. I really thought he would like to make a model. I thought that strategy would especially benefit the learning support students. I am glad to see that he completed the problem, and he found his own way to do it.

Figure 3. Part 2 of Mark's layered story.

I asked a few of the students to draw and write their L column responses on the board. I had noticed that two or three students still had not tried to solve the problem. I thought this would give them an idea as to how to solve the problem. It was helpful to do this because all of the students had a correct response after some of them modeled their responses on the board.

Mark had volunteered to go to the board and show his work. He seemed proud of what he did. When it was his turn to explain his answer, he just sat in his seat and stared blankly at the board. I had to help him explain his answer to the class. This was not the first time this happened. Mark sometimes had difficulty explaining an answer, even though he raised his hand to volunteer.

We completed two more problems in the lesson together in the same way as the first. Later, the students completed the entire chart alone. I offered the students a K-W-L chart to help them solve the problems on their homework. Twelve students asked for one of the charts. I was happy that the students wanted to use the K-W-L chart for homework. I thought that if we stuck with it they would find it useful, and now I know it.

Semantic Feature Analysis

I asked the students to complete a Semantic Feature Analysis (see Appendix O) about the features of expressions and equations. I created the chart with expressions and equations going down the first column. Across the top, I listed the vocabulary terms: expression, equation, variable, and parentheses. The students were asked to write *Y* for yes or *N* for no if the item in the first column matched the vocabulary term listed across the top.

I did not anticipate what was about to happen with this activity. The students had just taken a test on expressions and equations. I thought this would be a fairly easy activity. Was I wrong! The students were supposed to be completing the grid independently. They were being very talkative, mostly with social talking. Some of the students were trying to help each other since they were unsure of the vocabulary. I did remind them not to talk. Then I noticed that the students were not completing the chart. I reminded them to look in their vocabulary graphic organizers for help with the vocabulary words. Most of them were still not completing the chart. I decided to go over the four definitions with them and complete the first three problems together. After that, the students began working independently.

The students were successful once we went over the vocabulary again. Thirteen students had the entire chart correct. Four students had 1 wrong, and two students had 2 wrong. Two more students had 8 wrong, and one student had 10 wrong.

After the difficulty with this lesson, I decided that the students needed more vocabulary instruction and practice. This activity was based on the students having an understanding of the vocabulary words. Obviously, they did not have this without a review. I thought I was giving plenty of attention to vocabulary, but I saw I was wrong. I would need to put more effort into vocabulary instruction for the students to have a stronger understanding and use of the vocabulary words.

I followed my own advice and instructed the students more thoroughly on vocabulary through the rest of the chapter. At the end of the chapter, I gave a quiz. Part of the quiz involved matching vocabulary words to their definitions. All of the students completed this section of the quiz correctly.

Success Follows Change: Making Text Connections

I had noticed that the students were becoming more and more social as the weeks went on. I needed to do something to encourage more math talk and less social talk. I decided to change their seating arrangement. I tried to keep the groups mixed with students from both

classes. I also tried to move some of the more social students away from the students they spent a lot of time talking with. Lastly, I tried to put a student who had emerged as a leader at each group.

Drawing Conclusions

The next lesson was exciting for me. The students were learning to draw conclusions from line graphs. We were reading from our books and I was asking questions about the line graphs in the book. The students who were participating were using the information from their books. One student read directly from a caption to answer a question. Another student used information from a paragraph in the book to support his conclusion. I was so excited that they were using their books.

Venn Diagram

Another exciting display came during the following lesson. I created a Venn diagram to show the similarities and differences with three different types of graphs: bar graph, line graph, and picture graph (see Appendix P). The students were asked to help complete the diagram by writing features of the different graphs into the diagram. Many students participated in this lesson. They were excited to share their knowledge of the graphs. Many of the answers they gave were directly from the definitions we wrote about the graphs. I was proud to see their understanding and use of the vocabulary words beginning to emerge.

Math Literature

Another instance of great response to text came when we read the story, *The Doorbell Rang*, by Pat Hutchins. I gave the students some chocolate chip cookies, a plate, and a page to write division and multiplication equations. As I read the story and stopped as new characters entered, the students wrote a new division equation. Although this was a simple story for division, the students were able to use the story to understand the concept of division. The students wrote the inverse equation to check their division, and they also drew pictures to help with writing their division equations. The students showed great enthusiasm and participation during this lesson. Reading a story and having cookies as manipulatives served as great motivation for the students.

I decided to give the Interactive Reading Guide another chance since the students had been experiencing some success lately. The lesson was a bit simpler, and the students were excited to get started. As I observed groups of students, I noticed that they were following the guide and working in pairs or groups as they were completing each step of the guide. They were also using the strategy that worked best for themselves, not just copying from each other. They were also responding to the text and using the examples presented in the lesson.

Say Something Grid

I introduced another new strategy to students to illustrate different ways to respond to the text. I was teaching a problem solving lesson and used a Say Something Grid (see Appendix S). The students read a short section of text explaining a word problem. Then they looked at the two expression choices to match the words. Last, I asked them to respond to the problem on the grid. They were asked to write a response to something in the word problem or the answer. I left the opportunities to respond fairly open. After giving a few examples, the students were able to write their own responses.

Many of the student responses on the Say Something Grid involved making a real-life connection to the problem. They commented on the amount of money the character in the problem had saved, and how this amount related to the amount of money they had saved. They also connected to the fact that the character was doing chores to earn money, which is similar to some of their own experiences. Another popular manner of response was in the statement section of the grid. Students wrote their choice for what they thought was the matching expression for the problem. A few of them chose the wrong expression, but they still had great responses to the problem.

One of the greatest successes in using the Say Something Grid was that some of the students wrote up to four responses in the grid when they were only asked to write two responses. Even students who did not respond well to other writing activities were able to respond to the Say Something Grid. Only one student, Mark, did not write anything. Even after continued encouragement and sharing of examples, Mark still chose not to participate in this writing activity. The following layered story shows Mark's reluctance and my reaction during this activity (See Figure 4).

Mark's Story - Part 3

Mark

What does she want us to do this time? I think we are supposed to read the book and tell something about it. I don't really understand. I just don't get it. I hate writing! Uh oh, here she comes.

Me

Mark came in to math with a chip on his shoulder today. I never know what he'll be like, but I guess he is in a bad mood today. It was a bad day for him to have an attitude because we are writing today.

He's just sitting there at his seat. He doesn't even look like he's trying. Even though the aide is standing there trying to help him, I guess I'll go over to him and explain it again.

Mark

I still don't understand it, even after she explained it again. I don't like writing, especially about math. I wish she would just leave me alone. I don't know how all these other kids write so much and understand this thing. She is telling the other kids to say what they wrote to give us ideas, but I don't want to write what other people wrote. I guess I just won't write anything.

Me

He still won't write, even though the other kids shared their answers and I said you could write what someone else wrote. He's just being defiant now. I want him to participate, but I don't want to make writing a punishment. I'll just let it go this time and see what happens.

Figure 4. Part 3 of Mark's layered story.

Reaction Guide

Another strategy I used in which students were able to respond to the text was a Reaction Guide (see Appendix T). The students were given statements relating to a chart in their math books. They were asked to agree or disagree with the statements and use evidence from the text to support their answers. The students were very successful with this activity. They were able to understand, with the help of the Reaction Guide, how to write a rule and equation. Even students who usually had difficulty with more complex concepts were successful with this strategy. They were able to use the tables and find information to support their answers very easily. I think that the statements on the Reaction Guide helped to guide students' thinking about the lesson. This was helpful in scaffolding the learning for some students.

FINAL CONNECTIONS: STRATEGIES REVISITED

Say Something Grid

During the final use of the Say Something Grid, the students were again making connections to the text. Many of the connections, this time, were "wow" connections. Students commented on information from the problem, regarding the amount of bread sold by a bakery. Some also commented on the lesson being fun or even confusing. I was most impressed by their ability to say that the lesson was confusing. The

students who stated that it was confusing had been observed having difficulty during the lesson. I had helped three of the five students who found it confusing or difficult. The other two students were not found to be having difficulty during independent work time.

I also noted many students using their math texts during this lesson. I had noted that Peter had followed all of the directions I had given. He was following the lesson in the text and completed both parts of the problems correctly, including estimating and then multiplying. I had observed Joseph completing the problems incorrectly until he referred back to his text. He was then able to correctly complete the problems with the use of his text. Mark was able to write comments this time on his Say Something Grid, but his comments were superficial. He stated, “Wow, estimating is fun! This is fun. Why is this fun?” His second comment, however, was a connection that was similar to the other students. He commented on the amount of bread the bakery had made, which many other students noted as well.

Problem Solving K-W-L

During the last use of the Problem Solving K-W-L, I noted that the students wrote more of an explanation for their solutions to the problems. The students worked more independently to complete the entire chart and explained the steps in detail. Some of the students explained the steps,

including words such as: first, then, next, and last. Many also explained that they used estimation to check that their answers were correct.

The problems in this lesson were based on computation. Mark was very successful with completing the problems, and even wrote an explanation for his answers. Although he was not completely correct in his explanation, he quickly changed his answer once he was given some assistance. Mark's positive attitude and willingness to try are shown in the following layered story (see Figure 5).

Mark's Story - Part 4

Mark

I actually get it. I can do this problem because it is multiplication facts that I know. I know the facts, but I don't always think of them quickly. My mom helps me with them at home.

I guess I didn't explain my answer right. I was glad that Mrs. Behr helped me today. She is being nice and explaining it so that I understand. She is really happy for me.

Me

I was so glad to see that Mark was completing his chart today. He was finishing the problem quickly and even wrote an explanation. I checked his explanation and noticed a mistake. I'll help him to see that his explanation is not quite correct.

Wow, that was much easier than I thought. He was eager to erase and try again. I am so proud of Mark. He really gets this concept. He is even smiling at me today. This is the kind of work I know he can do everyday.

Figure 5. Part 4 of Mark's layered story.

Math Literature

Again the Math Literature sparked student interest to participate in the lesson. I noted that many hands were up wanting to participate. I also noted that many students were waving their hands to be called upon and even a few were calling out answers out of the excitement. The problems we completed were from the book, *Math Curse*. They were excited and

commenting that they wanted harder problems from the book. The students were also observed clapping for each other when they were answering questions out loud. This was a great feeling to have so many students participating and supporting each other.

Our Changing Histories: Math Autobiography II

The final piece of my study was the completing of the Math Autobiography II (see Appendix U). This was a survey that was similar to the Math Autobiography, but asked students to finish the statements thinking about their math experiences so far this year. The students were excited to complete this survey. Most of the students were smiling and eager to begin as I handed out the survey. During the first survey, I had to give examples of responses. This time, I did not need to give the students suggestions for completing the sentences. They were able to answer them all on their own.

Students still commented on word problems being hard, stating that they still do not understand them. Almost half of the students still felt that problem solving was hard. Students made interesting comments on the main point of reading a math book. Diane stated that the main point of reading a math book is, “learning new strategies and learning about the math book.” Joseph stated that it is “so you could get the point of what you do.” Madison thought that the main point of reading a math book is “so you

know what to do because if you don't read it you won't know what to do." This was a great change from her initial survey comment of, "to follow along."

Mark's comments did not change drastically from the initial Math Autobiography to Math Autobiography II. He first stated that math made him feel "confused," and later thought it made him feel "very bad because it was hard." He did, however, state that words in a math book "teach you things" on his Math Autobiography II. Mark continued to have good days and bad days until the end of the study, although his good days began to outweigh the bad. I have illustrated his changes in the "Afterwards" anecdote that follows (see Figure 6).

Afterwards

Although I still never knew which Mark would arrive at math class each day, Mark had more and more positive math experiences following the completion of the study. His class participation improved and he worked more cooperatively with other students. He was more willing to try written responses some days. Mark continued to test the limits, but he seemed to prefer to do the right thing more often.

Figure 6. Anecdote illustrating Mark's progress in math class following the study.

The most exciting change, for me, came with the student comments to how math makes them feel. Although not all of my students felt great

about math at the end of the study, many feelings had stayed positive or become more positive by the end of the study. I illustrated these comments in a pastiche (see Figure 7). This pastiche, Writing New History, matches the comments of each student on the Math History pastiche in figure 1. The comments on the left, the positive comments, had increased from the first pastiche. These comments were more enthusiastic than on the first pastiche. I was glad that many of the students were writing a new, more positive history. My comments were more positive as well.

WRITING NEW HISTORY

Math makes me feel...

Happy!

Happy, excited to learn more new things.

Intelligent, like my brain just wakes up.

tired because it is difficult for me.

happy in one way

excited to learn about new things

good because I like learning new things

good in the morning

very bored

ok

good because it helps us with our everyday lives

great

GOOD

not happy

very bad because it was hard

excited

happy

smart

very very happy!

normal because it is easy

happy

Figure 7. Pastiche using student responses from Math Autobiography II.

DATA ANALYSIS

"Data analysis is a way of 'seeing and then seeing again.' It is the process of bringing order, structure, and meaning to the data, to discover what is underneath the surface of the classroom" (Hubbard & Power, 2003, p. 88).

Analysis of the data occurred throughout the study. Data was analyzed during and after collection in various ways. I assigned codes to data in the field log, including observations, observer comments, student work, survey, and interview data. I wrote memos to further analyze and reflect on data collecting and processing. Then I organized data by placing codes into bins of common meaning and writing theme statements from these bins. Lastly, I represented and analyzed data in varying literary forms that allowed me to see deeper meaning in the data.

Analysis During Data Collection

"Interpretation (making sense of the data) is not a separate part of action research that comes at the end of a cycle: we are constantly trying to understand our students, their work, their world, and ourselves" (Arhar, Holly, & Kasten, 2001, p. 193).

Field Log Analysis

Data collection and analysis began with the field log. According to Ely, Anzul, Friedman, Garner, and Steinmetz (1991), "The log contains the

data upon which the analysis is begun and carried forward. It is the home for substance that we use to tease out meanings and reflect upon them as they evolve" (p. 69). I typed my log daily from log notes that I took during class. Then I reflected on the notes as part of the analysis process. I collected student work, survey results, and interview data as part of the log as well. As each of these pieces was added to the log, it was analyzed through coding, memos, and reflective responses. These data were used to drive further data collection.

Coding Analysis

Each week I reread the data that was collected in my field log. I made notes in the margins of the log that labeled units of meaning. This is often referred to as coding the log (Ely, Vinz, Downing, & Anzul 1997; Ely et al., 1991). As I read through the log each week, I recorded the codes in a coding index. They were recorded by label and page number so I could easily find them later.

I carefully considered each code, adding new codes and removing codes when necessary. MacLean and Mohr (1999) suggest that you "compare the new data to the previously categorized data to see how your categories hold up, revising where needed" (p. 61). This process involved going back over previously coded data and examining it for new insights. Through the coding analysis, I was able to see some patterns emerging in

the data. I was beginning to make sense of the data according to these patterns.

Student Work Analysis

The student work that I collected included Check What You Know worksheets, math tests and quizzes, and strategy worksheets. I examined the Check What You Know pages to see what skills students were lacking to learn the new concepts presented in the chapter ahead. I recorded results in my field log and reflected on these results. I also used the results of the Check What You Know pages to group students into mixed groups according to previous knowledge of the chapter concepts.

I graded quizzes and tests and recorded the results in my log. I reflected on the process of administering the test, as well as the results. I used these reflections to drive instruction and future test administration. For example, I noted that during the first few tests I had guided students through the test, often instructing on test-taking skills during the test. Later, I was able to change this practice and instruct on these skills prior to administering the test, allowing students to take the tests more independently.

I coded the strategy worksheets and reflected on what students were saying and doing while completing the worksheets during class.

These analyses were helpful in formulating research sub-questions and driving further data collection.

Survey/Interview Analysis

Students were surveyed at the start of the study to gather information on their math histories, learning styles, and use of math reading strategies. I read, coded, and reflected on these surveys. I surveyed the students again at the end of the data collection period with the same survey. I coded and reflected on these surveys as well. I used these reflections to gather interview data that helped to clarify some of the survey results.

I interviewed every student at the midpoint of data collection to gather information about student interactions and collaboration. I coded and reflected on this information as well.

Memo Analysis

In the middle of my data collection period I wrote a methodological memo to further clarify and focus my data collection. I listed each data source along with an insight gained from that source. Along with the data already collected, I listed future data sources and a rationale for each. This memo was extremely helpful in finding emerging themes in the data. I was also able to formulate research sub-questions that were emerging from the data collected to that point. These sub-questions aided in a focus

for data collection and instruction through the final period of data collection.

I closely examined students' use of figurative language in an analytic memo. Arhar, Holly, and Kasten (2001) described an analytic memo as, "a memo to yourself as what you see emerging: patterns of behavior, words, key ideas, events. . . . Analytic memos are personal field notes to ourselves, helping us to notice things we did not notice before" (p. 194). The instances of figurative language were taken from surveys, interviews, student work, and field log notes. Through this analysis, I was able to closely examine the impact of figurative language on the students' learning. I analyzed my own response to the students' use of figurative language.

Analysis Through Educational Philosophers

Another method of analysis involved comparing my data to educational theory. I read works from educational theorists John Dewey, Paolo Freire, Lisa Delpit, and Lev Vygotsky. I compared aspects of my study and data I had collected to the educational perspectives of these theorists in a series of reflective memos. I was able to connect data I had collected and aspects of my study with specific quotations from each of the theorists. Through these memos, I examined my data from varying educational perspectives, reflecting on the impact of certain data within

the context of these authors. I gained insight into student learning and experience with these reflective memos.

Analysis After Data Collection

"*Data analysis* is the process of systematically searching and arranging the interview transcripts, fieldnotes, and other materials that you accumulate to increase your own understanding of them and to enable you to present what you have discovered to others" (Bogdan & Biklen, 1998, p. 157).

Field Log Analysis

At the end of the data collection period, I continued to read my log and examine the codes I had assigned to the data. I had gone over the log multiple times to break it apart and make meaning. Ely et al. (1997) described this by saying, "Qualitative analysis requires that the researcher go back again and again over the accumulated log material in a process that for many has a cyclical feel" (p. 175).

Student Work Analysis

I examined collections of student work through graphic representations. I showed changes in test scores by comparing them in a grid. Next, I closely examined the students' written responses to text or problem solving activities. Finally, I examined the codes I had assigned to student problem solving strategies and test results.

Survey/Interview Analysis

Upon the collection of final surveys, I was able to compare the results of surveys administered at the beginning and end of data collection. I carefully examined student responses on both of these surveys. I used this information to draw conclusions about student learning during the study.

Bin and Theme Analysis

A part of the data organization process includes putting codes together that had similar meanings or pointed to a similar finding. These groups of common codes are called bins (Ely et al., 1997). The bins that I created were represented in a graphic organizer (see Figure 8). This graphic organizer was beneficial in making sense of the data I had collected. It allowed me to begin to see the patterns and relationships emerging in my data.

Each bin led me to extract meaning in the form of a theme statement. These statements, supported by data in my log, led to my findings.

Literary Devices as Analysis

The final method of analysis that I used was creating literary devices. Ely et al. (1997) stated, “Forms shape the subject matter to enrich meaning and understanding” (p. 59). I was able to analyze data and

gain further understanding in writing the various literary forms. The first form I wrote was a pastiche. I used this form to represent data from a survey I had given. This form showed that my students have various math backgrounds and feelings attached to these histories. Pastiche is just one example of the literary forms I used to represent and extract further meaning from the data I collected. These forms allowed me to represent the data in meaningful and interesting ways that contributed to a rich, colorful picture of my classroom.

Conclusion

Analysis of data was an ongoing process throughout the study. The data I collected were carefully and thoughtfully analyzed in a number of ways to give a broad picture of what was happening during the study. I collected participant observations, student work, and interview and survey data which I examined through different lenses. I was able to stay focused on my research question throughout the data collection process and use the data I had collected to gain a clearer focus and drive further data collection and instruction.

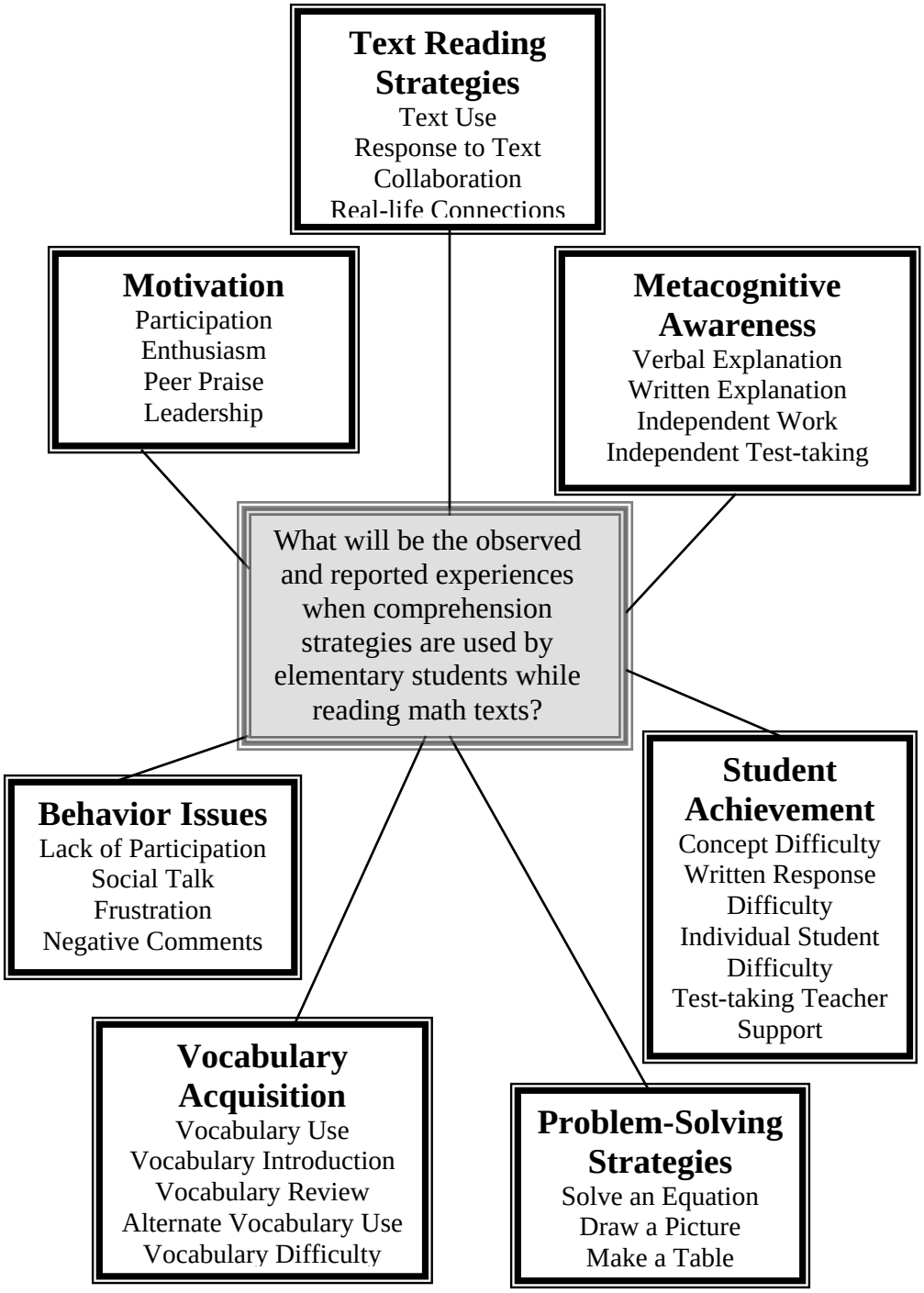


Figure 8. Graphic organizer representing bins.

FINDINGS

Introduction

The purpose of my study was to provide students with strategies to read and understand content materials in math class. I also wanted to provide students with opportunities to discuss these strategies with classmates. The findings from my study included increased use of text reading strategies, metacognitive awareness, and motivation. Students also exhibited vocabulary acquisition and problem-solving strategies as a result of increased strategy instruction.

Text Reading Strategies: **The use of text reading strategies increased due to explicit instruction in content reading strategies.**

Throughout the study, I introduced students to a variety of content reading strategies that were designed to help students understand how to use their math books. The students used their text books more with the increased number of strategies that were introduced. As the students were instructed in reading strategies with their math books, text use, response to text, collaboration, and real-life connections increased.

Some students showed a changing awareness of text use through their responses from Math Autobiography to Math Autobiography II. Carly was a good student who paid attention and complete her work. She was usually able to apply new learning quickly, often after the initial instruction.

Carly was willing to try. The area that Carly experienced the most difficulty was multi-step problem solving and interpreting information and answers to problems. She did well on tests, and achieved an A in math in the first marking period.

Carly's responses to the prompt, The main point of reading a math book is, did not change much from beginning to ending survey. Her first response, on Math Autobiography was, "so you can learn stuff and understand stuff that teacher says." Her response on Math Autobiography II was, "to learn about math and to help you if you don't understand." She included that you would learn about math and that you could use your book to help you if you don't understand what you are learning. Her responses to another prompt, Words in a math book are important because, showed a shift in thinking about the importance of vocabulary words in her math book. She first responded by stating, "you can learn from them." Her second response stated, "they tell you what to do." Carly also gave an example on the second survey identifying a link between words in a problem and an operation. She noted that sometimes when you see the word each in a word problem that it might mean to multiply to solve the problem. Carly's first response was one she might be expected to write. Her second response showed her ability to make a link between words and operations in her math book.

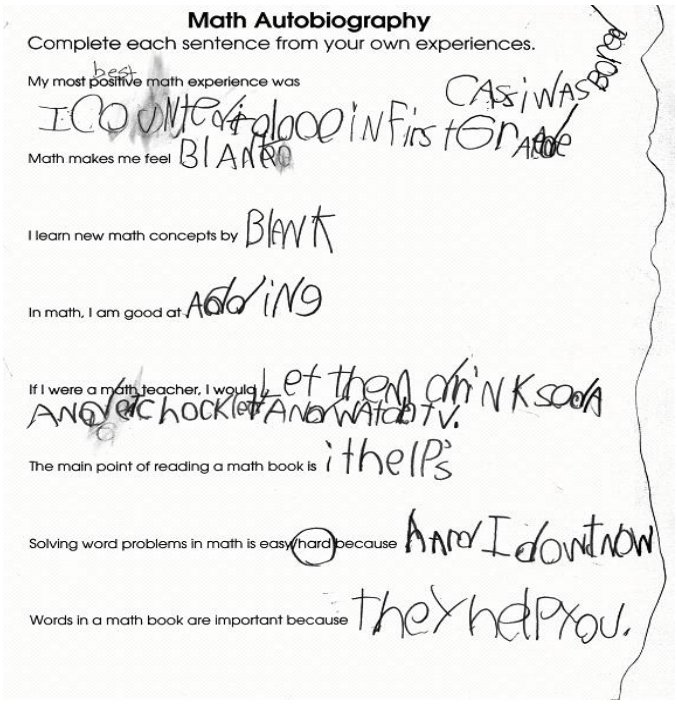
Christopher was another student who often did well in math. He also was able to apply new concepts quickly and achieved an A on his report card for the first marking period. Christopher's responses to the prompt, The main point of reading a math book is, showed a slight shift in thinking. On Math Autobiography, Christopher responded by stating, "to help you learn new things your teacher can't explain." His response on Math Autobiography II, "to understand or learn new techniques," shows a different use of his math book. Christopher now understands that the math book is not only there to support your learning, but it can also help you learn something new.

Diane, a student who was identified as remedial in math, often needed extra support and guidance throughout math lessons. She did not understand concepts quickly and lacked confidence in her own abilities. Diane often needed an adult supporting her through independent work to be successful, even if the adult was just standing next to her encouraging her. Diane expressed feelings of nervousness on the initial Math Autobiography because she thought that she would not understand something in math. Her feelings had not changed much by the end of the study stating that math makes her feel, "tired because it is difficult for me." Diane may not have gained confidence during the study, but she did gain an understanding for the use of her math text. She first stated that reading

her math book is, “to learn more math.” At the end of the study, she stated the main point of reading in the math book is, “learning new strategies and learning about the math book.” She was able to identify that we had learned new strategies from reading our math book and we also had learned how to use the different features of our math book.

Tom, a learning support student, wrote responses such as “Blank” and “I don’t know” on the Math Autobiography. His responses to the Math Autobiography II were much more thoughtful. He stated on Math Autobiography, that the main point of reading a math book is, “it help’s.” On Math Autobiography II, Tom responded as the main point of reading a math book, “to learn about new stuff.” He had also identified that new learning can be achieved through reading in your math book. I have included both of Tom’s Autobiographies to show the marked improvement in his responses from the beginning to end of the study (see Figure 9).

Results of this type were also noticed by Dreher, Davis, Waynant, and Clewell (1997) in their examination of the effects of research strategy instruction on fourth-grade students. They found a significant increase of students’ use of appropriate resources. Similarly, I found that my students could identify and use their math book as a resource to support their math learning.



Math Autobiography

Complete each sentence from your own experiences.

My most positive math experience was I COUNTED 1000 IN First Grade CAS I WAS BORED

Math makes me feel BLANK

I learn new math concepts by BLANK

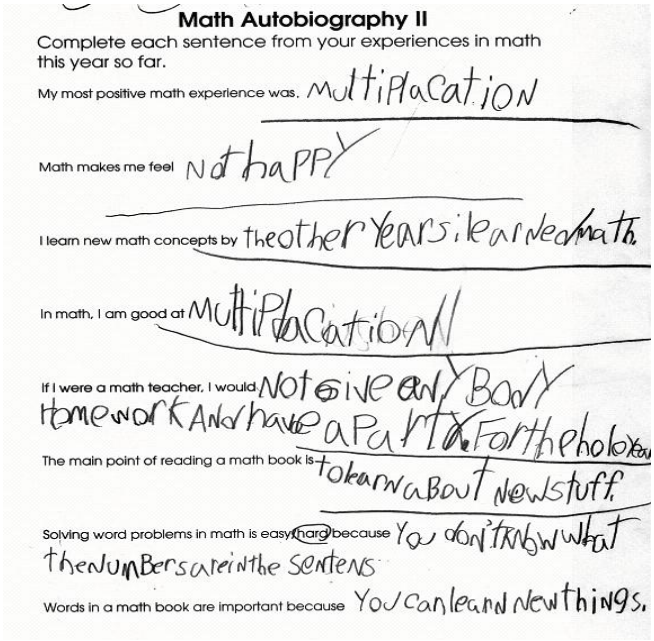
In math, I am good at ADDING

If I were a math teacher, I would Let them drink soda And eat chocklet And watch TV.

The main point of reading a math book is i the lPs

Solving word problems in math is easy/hard because And I dont now

Words in a math book are important because they help you.



Math Autobiography II

Complete each sentence from your experiences in math this year so far.

My most positive math experience was. Multiplacation

Math makes me feel Not happy

I learn new math concepts by the other years i learned math.

In math, I am good at Multiplacation

If I were a math teacher, I would Not give any Body Homework And have a Party For the holoxen

The main point of reading a math book is to learn about New stuff.

Solving word problems in math is easy/hard because You don't know what the Numbers are in the sentens

Words in a math book are important because You can learn New things.

Figure 9. Math Autobiography and Math Autobiography II completed by Tom.

Students were able to make real-life connections to the text, especially during activities such as the Say Something Grid. Many students were able to connect to one particular problem because it involved a student earning allowance. Many of the students connected to either the amount of money in the problem or the fact that the character in the problem was earning money. The students also made a few connections during the second use of the Say Something Grid. Some students, although there was less frequency of the real-life connections, still made connections to the problem in the book. For example, one student commented that in the problem the characters were making bread and that she enjoys making bread also. Students' ability to make real-life connections showed their increase in text reading.

***Metacognitive Awareness*: Increased metacognitive awareness resulted from explicit strategy instruction.**

The students showed metacognitive awareness through verbal and written explanations, independent work, and independent test-taking. I began by providing students with opportunities to verbally explain their solutions to problems. After that, we moved to written explanations. The student responses to these activities increased with further strategy instruction. The students also showed increased metacognitive awareness during independent work and test-taking.

I found that students were increasingly aware of their learning processes through verbal and written explanations throughout the study. Vacca and Vacca (2005) stated that students would become aware of their own learning processes through strategy instruction. I followed this thinking throughout my study. I scaffolded student explanations by beginning with Group Retelling activities where all group members were responsible for taking part in the retelling of the solution to the problem or task. Next, the students worked on Paired Retellings, where they listened to a partner explain his or her solution to a problem. The partners were instructed to help each other give a thorough explanation of the solution. Following that, students were asked to complete Written Retellings, which were written solutions to problems.

During the first Written Retelling activity, many students completed work steps on the retelling sheet without an explanation of this work. Students such as Logan, Carly, and Christopher, who were very successful in verbal retelling activities, had little or no explanation written on the first Written Retelling activity. During a later Written Retelling activity, these same students wrote responses that explained their work. With further strategy instruction, these students became more aware of the processes they used and were more easily able to write an explanation of these processes.

Some of the students, including Madison, Anthony, and Victoria, were successful on all of the activities. They were able to complete a verbal retelling with ease and wrote extensive explanations on both beginning and later Written Retelling worksheets. They had an understanding of their own thought processes throughout the study.

During the administration of the first few math tests, I made accommodations for all students. I read each question on the first two tests and gave verbal cues to remind students to show their work and follow specific directions. I soon realized that these accommodations should be reserved for a small number of students who needed special attention, rather than the entire class. As students were allowed to complete tests independently without special accommodations, they became more independent at following directions and completing problems. The students did not experience this independence instantly. On a quiz immediately after stopping the test accommodations, all of the students completely missed a direction to complete an extra column on a table on the quiz. I discussed this with the students and they became more aware of following directions on subsequent tests.

***Motivation*: Student motivation improved through increased participation, enthusiasm, peer praise, and leadership.**

There were many instances in my field log where I noticed that not many students were participating. There were times when I noted that some students were even sitting with their heads down at their desks. These instances, although they continued to occur throughout the study, decreased with the collaborative nature of the content reading strategy instruction.

Student participation and enthusiasm were especially high during Math Literature activities. I noted in my field log that almost all of the students in the class were volunteering answers during the second Math Literature Activity. They wanted to share equations they had written to go along with the math story they were reading. I also noted that students were engaged in math talk during the activities with the story, *The Doorbell Rang*.

Students also showed increased participation and enthusiasm during the Say Something activities. I was reluctant at first with this activity, because I thought the students would have a difficult time making connections to the text. However, I was surprised by the students and noticed that some of them were able to make more connections to the text than I had required. Kevin, an ESL student who chose to not participate in

an earlier retelling activity, was able to write three responses on the Say Something Grid. His “question” and “wow” responses were related to a character in a problem about making money. His “opinion” response was that the problem was difficult to figure out. I was pleased that Kevin was confident enough at this point in the study to write responses without hesitation. I realized that he was benefiting from the strategy instruction.

This experience relates to an important quote from Vygotsky (1978) regarding children’s writing. He stated, “Writing should be meaningful for children, that an intrinsic need should be aroused in them, and that writing should incorporate into a task that is necessary and relevant for life” (p. 118). Students being able to connect this math activity to their lives made it more intrinsically satisfying for them. They were more motivated to complete the task when they were able to connect it to their own experiences.

The first instance of peer praise came during a collaborative activity in a group that was having difficulty working together. (This story was dramatized earlier in the thesis, see p. 56) Peer praise continued to occur throughout the study. On another occasion, I observed a group working together on a collaborative activity. Similarly, one student was encouraging another through the problem and praising good work. The other occasions of peer praise mostly occurred with students encouraging

the ESL students. Many times, I observed groups working collaboratively to support the English Language Learners in their groups. Many students worked with them and praised the students often for completing tasks.

Students were also observed clapping and cheering for students who responded correctly on the board. During one lesson, I had students draw or write their solutions to elapsed time problems on the board. Following the students' explanations of their solutions, the class clapped for them. They also clapped for specific students, especially when they were experiencing difficulty and finally completed a problem correctly.

A few students emerged as leaders during collaborative activities and continued to lead as the groups were changed. Carly often led her groups through activities. She often took the role of recording the written information in a group and helped lead the group to decisions. Madison worked in her groups similarly to Carly. She also often took the writing job in the group and led the group to decisions. Madison also finished tasks quickly and helped students in her groups to complete their work.

Logan was another emerging leader that I noticed during the study. He often praised the work of the ESL student in his group and also led the group through activities. I also observed Logan assigning turns to students in his group to create a sense of equality within the group. During one activity, Logan was directing group members to take turns reading and

answering the questions. He was checking with all group members to be sure that they agreed with the answers and was praising the group members as they answered the questions.

***Vocabulary Acquisition*: Students exhibited vocabulary acquisition through vocabulary use in discussion, collaboration, written responses, and test-taking.**

Math vocabulary acquisition was achieved through increased vocabulary introduction and review. The students used alternate vocabulary when correct terms were not used and experienced minimal vocabulary difficulty with increased instruction. Students showed an increase in vocabulary use in discussion and written responses. They also showed increased vocabulary awareness on tests.

In an early lesson on *Benchmark Numbers*, the students were using the alternate vocabulary word, layers, to describe the word benchmark. They used alternate vocabulary for *greater* and *less than*, and often to describe the *inverse* they would say the “opposite” operation. The students became increasingly aware of the correct vocabulary words as vocabulary instruction increased. Near the end of the study, students were writing written responses on a Written Retelling worksheet. Many of the students described the strategy they used to solve the problem as the

“inverse operation” and showed a multiplication problem to solve a division problem in their work.

I noted an increase in vocabulary use by students during collaborative activities and class discussion when my instruction and review of vocabulary increased. During the unit on multiplication and division, I reviewed the vocabulary words on a daily basis. I began each lesson by asking questions about the vocabulary words we had learned. The students were given opportunities to identify numbers in an equation by the correct vocabulary term. They also gave definitions of the vocabulary words as we reviewed them. I noticed an increased use of words such as: factor, product, equation, estimate, variable, and basic fact. The students had been explicitly instructed in the use of these words on a daily basis, which had then improved their use of the words.

This improvement is supported by researchers Harmon, Hendrick, and Wood (2005). They recognized that vocabulary instruction in mathematics can vary with the type of word that is being instructed. They cited that the use of graphic organizers and discussion also supported students’ understanding of mathematical concepts. Teachers must also help students recognize that the context in which a term is applied can change the meaning significantly. Various modalities, including writing, speaking, and visualizing have been shown to support student acquisition

as well. I used a vocabulary graphic organizer to introduce new vocabulary to students. The students wrote a definition and a drawing or symbol for the word. Then, through discussion and writing, the students were able to review and practice the vocabulary terms in their appropriate use.

***Student Achievement*: Explicit comprehension strategy instruction increased student achievement, resulting in low, moderate, and high test success.**

Student achievement was impacted by various factors throughout the study. Low, moderate, and high test success were noted throughout the study. Low test success was often linked to concept difficulty and individual student difficulty. Moderate and high test success was noted more often on chapter tests rather than unit tests. Teacher support also affected student achievement on tests.

A grid showing high, low, and average scores on unit tests shows that achievement varied from unit to unit (see Figure 10). Although there is no clear pattern shown in the table, the concepts on Units 2 and 3 tests were more difficult for students. The first two units reviewed concepts that the students had been exposed to in previous years. The second two units included the concepts multiplication and division. These concepts were more difficult for students to understand and led to low and moderate test

success. I did note, however, that the average and low scores increased from Unit 3 to Unit 4. Also, fifteen students scored higher on the Unit 4 test than the Unit 3 test.

Class Test Score Summary

Test Summary	Unit 1 Test	Unit 2 Test	Unit 3 Test	Unit 4 Test
High Score	100	100	100	98
Average	85	88	80	86
Low Score	44	69	56	63

Figure 10. Summary of student test scores including high, average, and low scores.

In the beginning of the study, I supported student test-taking by reading the questions on the test. I guided students through the Unit 1 test in this manner. Following that test, students were given tests independently. Accommodations were only made for students with identified needs. This, along with difficulty of concepts, may have affected student achievement.

***Problem-solving Strategies*: Students increased their problem-solving skills by solving an equation, drawing a picture, and making a table.**

Many of the students responded, on Math Autobiography, that they had a hard time solving problems. This had been an area in the beginning of the study where the students often lacked participation during problem solving instruction. Through various strategy instruction, students were able to solve problems by writing and solving equations, drawing pictures, and making tables.

During an early problem solving activity, the students were encouraged to make a table to solve the problems in the book. I instructed students on the Make a Table Strategy, but I did not tell them how to make the table for the problem they had to solve. The students then had time to solve the problem on their own. Some students solved it by making a table. A few students drew pictures or created other graphic representations to solve the problem. Other students preferred to solve the problem through writing equations and solving them. There were students who did not know how to solve the problem and only began after some other students shared their own examples.

On subsequent problem solving activities, more students were able to solve the problems on the first try. The use of drawings and tables increased following further strategy instruction.

I found it interesting that Mark, a learning support student, preferred to solve problems through basic equations. I thought he would benefit from one of the more visual strategies, such as pictures or tables. Mark often quickly solved problems by writing equations. He was quick with addition and subtraction facts, and used many interesting strategies to solve greater addition and subtraction problems. For example, he was able to add the tens and ones separately to break the problem down into smaller parts. Mark did not draw pictures or make tables to solve problems unless that was his only option. He would sometimes draw a picture to help him find the answer to a multiplication or division problem, but many times he would just skip count or add multiples to solve these problems.

The Math Autobiography responses revealed an increase in the number of students who identified problem solving as “easy” by the end of the study. On the initial Math Autobiography, 16 students found problem solving hard for various reasons, many citing that they “don’t understand” this type of problem. On Math Autobiography II, 10 students still identified problem solving as “hard,” again citing lack of understanding or that the problems are “confusing.”

Jillian, a remedial student, initially identified problem solving as “easy and hard” because she did not understand some of the problems. On the final survey, Jillian stated that problem solving is easy, “if you know how to do it.” Jillian often used drawing and making a table to solve problems. Her problem solving improved throughout the study, but she still needed support from the Remedial Assistant on some problem solving tasks.

Emily was a student who had difficulty with many math concepts. She struggled to achieve a C in the first marking period. I recommended her for the Remedial Support Program, but she was not accepted for assistance. I often spent time working with Emily individually. I found her to be especially good at Written Retellings. Emily identified word problems as “hard” on the first survey because, “they are confusing.” On the Math Autobiography II, Emily responded that solving word problems is easy because, “they have clues all around them so they are pretty easy.” We had spent many class periods identifying key words in word problems that would help us to identify operations. On the first problem solving activity, Emily waited to see how other students solved the problem before attempting to solve it herself. She continued to need support when solving problems, but eventually tried on her own. She was not always successful, but she had an obvious awareness of the clues in the problems.

Evan was a math student who initially identified math as making him feel “mad because it was hard.” He struggled with some new concepts, but did well when he would focus and complete his homework. Evan did have difficulty in math during a period of time when he was distracted in class, fooling around, and not completing his work. These difficulties did not last long and were alleviated with some parental support. Evan identified solving word problems as “hard” on the initial survey stating, “I always need help.” At then end of the study, Evan stated that math makes him feel, “very very happy!” He also responded that solving word problems is “easy because I practice.” Evan often wrote equations to solve word problems, but he benefited from drawing pictures as well.

***Problems or Challenges*: Lack of participation, social talk, frustration, and negative comments presented behavior issues throughout the study.**

The challenges that I faced during the study included behavior issues that resulted from content difficulty, strategy instruction, and collaboration. When the content was difficult for students, they participated less than with easier content. Students’ episodes of social talk increased at times throughout the study. Frustration and negative comments were noted during the implementation of various strategies and during

collaborative activities. Students also exhibited frustration with difficult content.

Difficulty with content led to lack of participation and frustration. Students had difficulty with the content of a lesson early in the study. They were not familiar with the vocabulary of place value, so they were not successful with the new place value concepts. They were quickly frustrated with only a few students able to participate. Students also exhibited frustration with some problem solving activities. The content was often more difficult than computation activities. Student participation often decreased during problem solving activities.

Mark and Tom, learning support students, often made negative comments during lessons. These comments often came when I did not allow them to use a multiplication chart for basic multiplication facts. Tom told me one day that it was, “not fair” that I would not let him use it. Neither student had difficulty memorizing other information, so both were capable of memorizing the facts as I had instructed the other students in the class. I did not feel they needed that specific accommodation. I spoke with the learning support teacher who agreed that they did not need this accommodation. Mark often refused to complete written responses on activities. He reluctantly wrote a few words when insisted upon by the learning support aide or me.

I often observed students engaging in social talk during collaborative activities and at the beginning of class. I noticed this increased the longer that the groups were together. I also noticed that certain students were more prone to social talk than others. Regrouping students was done when social talk increased greatly.

Conclusion

There were many insights gleaned from collecting and analyzing the data of my study. I found increases in the use of text reading strategies, vocabulary, and problem-solving strategies. I also noted an increase in motivation and metacognitive awareness. Although some behavior issues resulted, the positive outcomes outweighed these issues. Students became more aware of how to use their math texts. They were able to respond to text in various ways by the end of the study.

NEXT STEPS

My students benefited from explicit reading strategy instruction with math text. Vocabulary use, metacognitive awareness, text use, and problem solving strategy use increased with explicit strategy instruction. Student collaboration, an integral part of the study, led to increased peer praise and leadership. Student achievement was also affected by the instruction in reading strategies.

Student use of vocabulary increased due to increased vocabulary instruction and review. This benefited students in their verbal and written responses and on tests. I would like to take this concept further with the use of a Math Word Wall that is organized by concept, as suggested by Harmon, Hendrick, and Wood (2005). Students had difficulty delineating between symbols, operations, and various concepts. Organizing the vocabulary words into categories would allow students to see these differences and possibly further support their use of vocabulary.

Another step I would consider is using successful strategies more often. Students will benefit differently from strategies. Since students do not all learn the same way, varying strategies was important. Although they did not all benefit from all of the strategies, some of the strategies were more successful than others. Students were very successful with the strategies, Sequencing Text, Say Something, and Math Literature. I would

consider using these strategies more often, since students experienced great success with them.

The students were enthusiastic and participated at a high level with certain strategies. I would like to further examine when student participation and enthusiasm were high and try to implement strategies to keep these aspects of learning high. The students and the teacher find teaching and learning more enjoyable when enthusiasm and participation are high. My comments were obviously much more positive on these occasions and I would like to increase the number of days when this occurs.

My students continued to have difficulty with following directions throughout the study. This is an area I would consider researching further. It is important to read and follow directions to be successful. I would like to make my students more aware of their reading and following of directions.

Another area of difficulty for students came with certain concept instruction. Some concepts posed greater difficulty for students, which led to strategy difficulty. I would like to carefully examine this content and try to implement strategies that would assist student learning of these concepts rather than cause them more difficulty.

Two more areas I would consider studying would be needs-based grouping and problem solving. I wonder if students would benefit more

from mixed-ability groups in math or needs-based grouping. Grouping for math is done consistently across the district. As a child, I was impacted negatively by being placed in a needs-based group in school. I believe that I would have been more comfortable and felt more successful in a mixed-ability group for math. I wonder how many of my students feel the same way.

I would also like to implement a study focusing on problem solving. This continues to be an area of difficulty for my students. Many of them would benefit from further instruction in problem solving strategies and focusing on written explanations for problems.

Finally, since so many successes were experienced with content reading strategy instruction with math texts, I would be interested in trying some of the strategies in other content areas. I teach science to all of the students in fourth grade at my school. I know that many of the strategies I read about and used were also science reading strategies. I would like to try these strategies in science and have the students experience as much success with reading their science text.

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Appendix A

May 16, 2006

Dear

I am currently taking a course toward my Master's degree at Moravian College. The Moravian program is a teacher action research program that encourages us to reflect on our own teaching practices. I also spend time reading current research on teaching and learning. The Moravian College program helps me stay in touch with the most effective ways of teaching so that I can provide the best learning experiences for my students.

The work required for the course I am currently taking involves conducting a systematic study of my own teaching. The focus of my research this semester is the use of content reading strategies in math and science. Content reading strategies provide students with the tools to read content texts, such as math and science books. I hope to help students become more aware of their use of content reading strategies. Increasing the use of content reading strategies will help students to learn more from what they read in math and science. I also hope to see students use these strategies with all content texts they read.

I will be gathering information to support my study through observations, student interviews, surveys, and work samples. I will only use information collected from students who have permission to participate in the study in any written reports of my research. All of the students' names will be kept confidential as well as the names of teachers and other staff, and school names. Any information that may reveal a student's identity will be altered to protect anonymity. No names will be included on work samples or in any reports of my study. Any child may withdraw from the study at any time without penalty. If a child is withdrawn, I will not use any information pertaining to him or her in my study.

My faculty sponsor is Dr. Charlotte Zales. She can be contacted at Moravian College by phone at

If you have any questions or concerns about my in-class project, please feel free to contact me at school. If not, please sign and return the bottom portion of this letter. Thank you for your help.

Sincerely,

Megan Behr

I attest that I am the principal of the teacher conducting this research study, that I have read and understand the consent form, and received a copy. Megan Behr has my permission to conduct this study at

Principal's signature: _____ Date: 5/18/06

Appendix B

September 7, 2006

I am currently taking a course toward my Master's degree at Moravian College. The Moravian program is a teacher action research program that encourages us to reflect on our own teaching practices. I also spend time reading current research on teaching and learning. The Moravian College program helps me stay in touch with the most effective ways of teaching so that I can provide the best learning experiences for my students.

The work required for the course I am currently taking involves conducting a systematic study of my own teaching. The focus of my research this semester is the use of content reading strategies in math. Content reading strategies provide students with the tools to read content texts, such as math and science books. I hope to help students become more aware of their use of content reading strategies. Increasing the use of content reading strategies will help students to learn more from what they read in math. I also hope to see students use these strategies with all content texts they read.

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My faculty sponsor is Dr. Charlotte Zales. She can be contacted at Moravian College by phone at

If you have any questions or concerns about my in-class project, please feel free to contact me at school. If not, please sign and return the bottom portion of this letter. Thank you for your help.

Sincerely,

Megan Behr

Megan Behr

I attest that I am the principal of the teacher conducting this research study, that I have read and understand the consent form, and received a copy. Megan Behr has my permission to conduct this study at

Principal's signature _____ Date: 9/8/06

Appendix C

1 7 4 2

MORAVIAN COLLEGE

July 21, 2006

Dear Megan Behr:

The Moravian College Human Subjects Internal Review Board has accepted your proposal : Using content reading strategies in mathematics and science in elementary school. Given the materials submitted, your proposal received an expedited review. A copy of your proposal will remain with the HSIRB Chair.

Please note that if you intend on venturing into other topics than the ones indicated in your proposal, you must inform the HSIRB about what those topics will be.

Should any other aspect of your research change or extend past one year of the date of this letter, you must file those changes or extensions with the HSIRB before implementation.

This letter has been sent to you through U.S. Mail and e-mail. Please do not hesitate to contact me by telephone ( ) or through e-mail should you have any questions about the committee's requests.

Debra Wetcher-Hendricks
Chair, Human Subjects Internal Review Board
Moravian College
610-861-1415

1200 MAIN STREET • BETHLEHEM, PENNSYLVANIA 18018-6650 • (610) 861-1300

Appendix D

September 8, 2006

Dear Parents,

I am currently taking a course toward my Master's degree at Moravian College. This course work helps me stay in touch with the most effective ways of teaching so that I can provide the best learning experiences for my students.

The work required for the course I am currently taking involves conducting a systematic study of my own teaching. The focus of my research this semester is the instruction of content reading strategies in math. Content reading strategies provide students with the tools to read content texts, such as math and science books. I hope to help students become more aware of their use of content reading strategies. Increasing the use of content reading strategies will help students to learn more from what they read in math. I also hope to see students use these strategies with all content texts they read.

I will be gathering information to support my study through observations, student interviews, surveys, and work samples. I will only use information collected from students who have permission to participate in the study in any written reports of my research. All of the students' names will be kept confidential as well as the names of teachers and other staff, and school names. Any information that may reveal a student's identity will be altered to protect anonymity. No names will be included on work samples or in any reports of my study. Any child may withdraw from the study at any time without penalty. If a child is withdrawn, I will not use any information pertaining to him or her in my study.

My faculty sponsor is Dr. Charlotte Zales. She can be contacted at Moravian College by phone at

If you have any questions or concerns about my in-class project, please feel free to contact me at school, If you approve of your child being a participant in my teacher research, please sign and return the bottom portion of this letter. Please notify me by phone or in writing if your child wishes to withdraw from the study at any time. Thank you for your help.

Sincerely,

Mrs. Behr

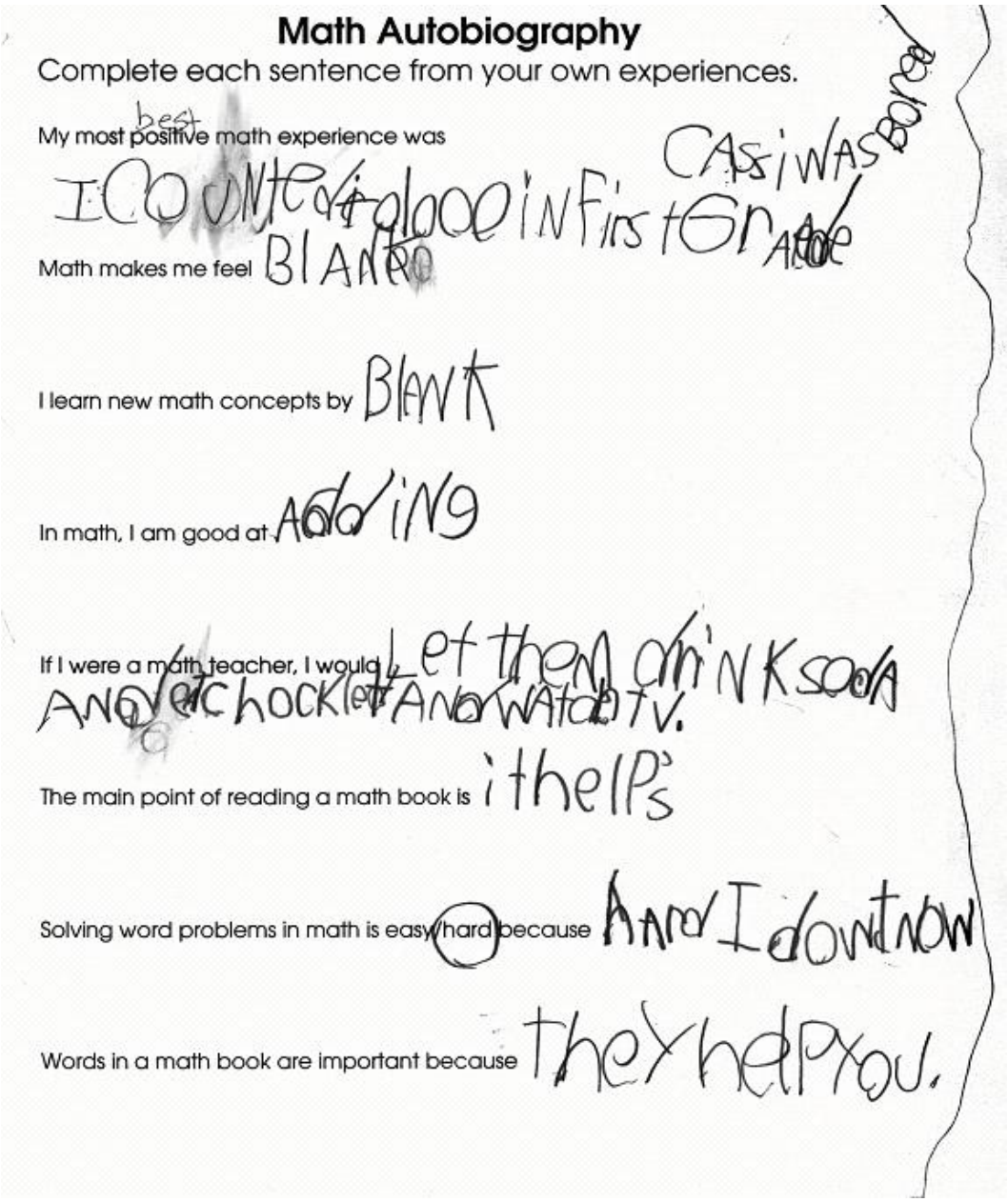
Mrs. Behr

I understand that Mrs. Behr will be observing and collecting data as part of her research on content reading strategies, and my child has permission to be a participant in the study

Child's name: _____

Parent's signature: __

Appendix E



Math Autobiography

Complete each sentence from your own experiences.

My most ~~positive~~ best math experience was I COUNTED 1 TO 100 IN FIRST GRADE CAS I WAS BORED

Math makes me feel BLANK

I learn new math concepts by BLANK

In math, I am good at ADDING

If I were a math teacher, I would LET THEM DRINK SODA AND ETC CHOCKLET AND WATCH TV.

The main point of reading a math book is i THELPS

Solving word problems in math is easy/hard because AND I DONT NOW

Words in a math book are important because THEY HELP YOU.

Adapted from Vacca & Vacca (2005)

Appendix F

Text Reading Strategies

Activate Prior Knowledge

Understand Vocabulary

Set a Purpose

Use the Text Features

Discuss the Text

Monitor Comprehension

Appendix G

Unit 1 Math Vocabulary

Word	Definition	Picture/Example

Appendix H

1	Date	48	Reflection
2	Observation	49	
3		50	
4		51	
5		52	
6		53	
7		54	
8		55	
9		56	
10		57	
11		58	
12		59	
13		60	
14		61	
15		62	
16		63	
17		64	
18		65	
19		66	
20		67	
21		68	
22		69	
23		70	
24		71	
25		72	
26		73	
27		74	
28		75	
29		76	
30		77	
31		78	
32		79	
33		80	
34		81	
35		82	
36		83	
37		84	
38		85	
39		86	
40		87	
41		88	
42		89	
43			
44			
45			
46			
47			

Appendix I

Sample Quiz

Find the sum or difference. Write the method you used to compute.

1. 324,865 + 224,997

2. 737,087 – 443, 854

3.
$$\begin{array}{r} 653{,}800 \\ +\ 45{,}811 \\ \hline \end{array}$$

4.
$$\begin{array}{r} 168{,}927 \\ -101{,}774 \\ \hline \end{array}$$

Tell whether an estimate or an exact answer is needed. Solve

5. Jake earns $4.50 and hour. How much does he earn in 4 hours?

6. The Kim family must travel 126 miles south and 203 miles east to get to the ocean. About how far must they travel?

7. Two science classes need science books. There are 25 students in one of the classes and 32 students in the other class. How many science books are needed if each student gets a book?

Appendix J

Interactive Reading Guide
Lessons 1.2-1.4

Work individually	Work in a small group
Work in pairs	Work as a whole class

Place Value

1. Review vocabulary.

2. Read and discuss pages 4, 6, & 8.

3. Complete examples on RW 4.

4. In pairs, complete problems 1-6 on RW 4.

5. In pairs, complete problems 1, 3, 5, & 9 on pages 9-10. Check answers with small group members.

6. Complete problems 15, 17, 19, 21, & 22 on page 10. Discuss answers with your group members. Each group member should be ready to explain the answers.

Adapted from Wood (1992)

Appendix K

Sequencing Text Worksheet
Lesson 2.1

Compare the millions.
Start with the first place on the left.
Compare the hundred thousands.

Appendix L

Group Retelling Worksheet

Tell whether the values on both sides of the equation are equal. Write yes or no. Explain each step with your group.

1. 1 dime + 4 nickels = 1 quarter + 2 nickels

2. 5 pennies + 1 dime = 1 quarter

Make the equation true. Explain each step with your group.

3. ____ + 5 = 10 + 3 + 1

4. 9 + 9 = ____ + 11

Appendix M

Paired Retelling Worksheet

Find the sum or difference. Explain each step to your partner.

1. 6,798
   - 4,172

2. $3,204
   -$2,413

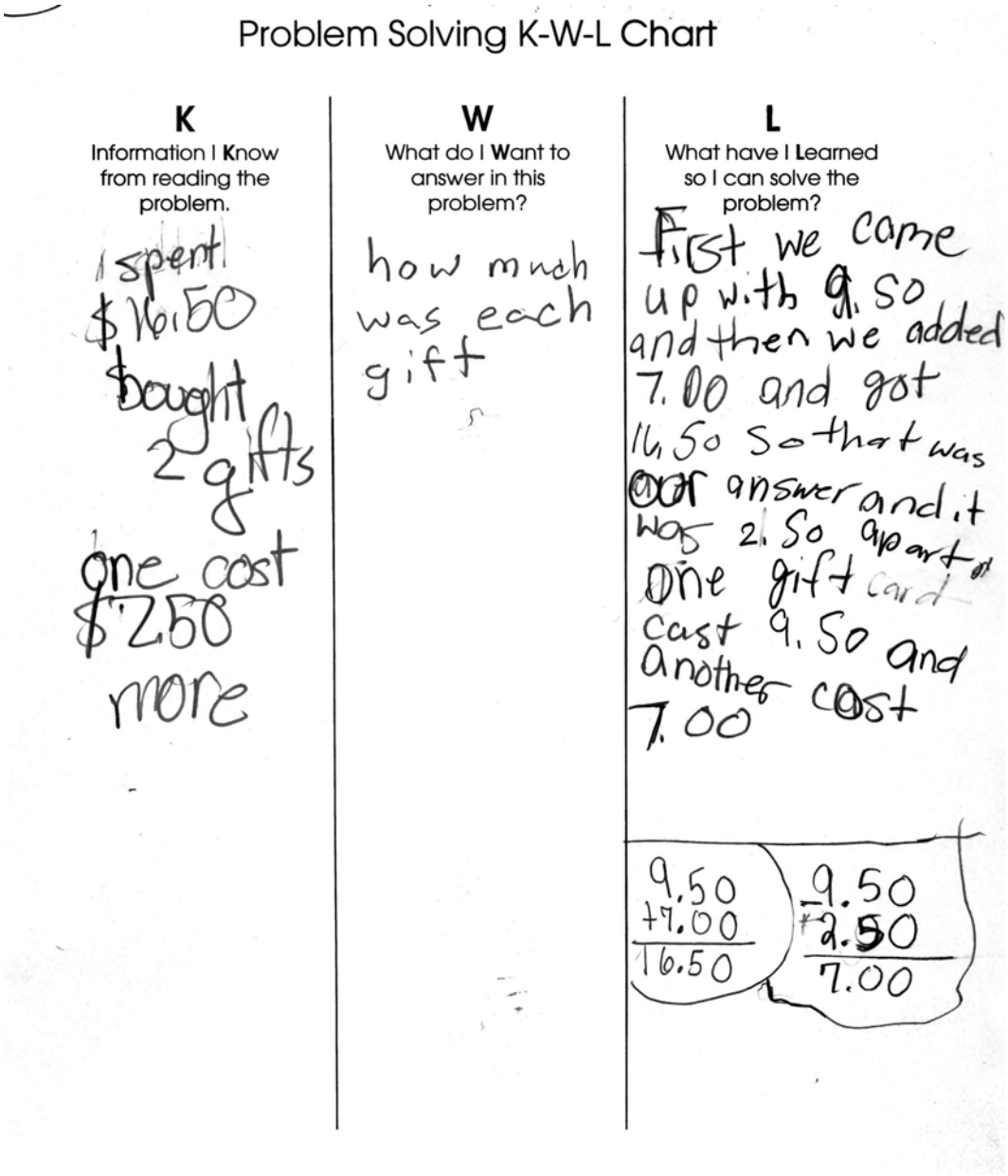
3. 2,409
   +5,726

4. 2,90_
   - 1,894
   1,007

5. 3,486
   +_,964
   9,450

6. $3,228
   +$4,228

Appendix N



Problem Solving K-W-L Chart

K Information I Know from reading the problem.	W What do I Want to answer in this problem?	L What have I Learned so I can solve the problem?
I spent $16.50 bought 2 gifts one cost $2.50 more	how much was each gift	First we came up with 9.50 and then we added 7.00 and got 16.50 so that was our answer and it was 2.50 apart one gift card cost 9.50 and another cost 7.00 9.50 + 7.00 = 16.50 9.50 − 2.50 = 7.00

Adapted from Reehm & Long (1996)

Appendix O

36/36

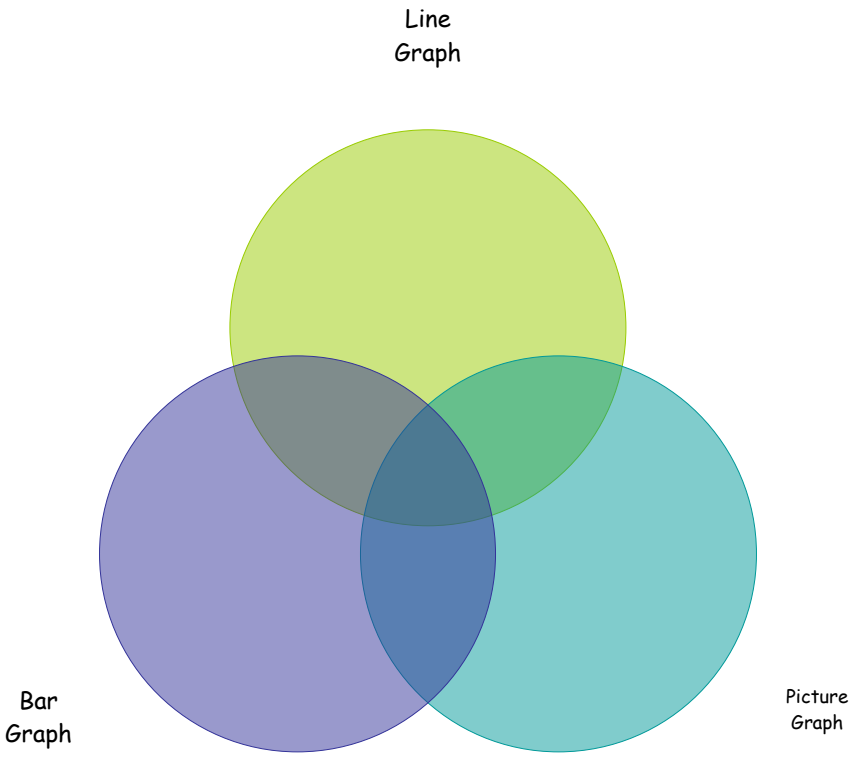
Semantic Feature Analysis
Chapter 4

Determine which of these features each has. Mark "Y" or "N" in each box.

	Expression	Equation =	Variable	Parentheses
4 x n	y	n	y	n
10 – (4 + 3)	y	n	n	y
t x 8	y	n	y	n
5 x n = 10	n	y	y	n
(4 + 3) – 5	y	n	n	y
17 – 5 = y	n	y	y	n
4 x p	y	n	y	n
(5 + 6) x 3	y	n	n	y
8 + 2 = 2 x 6	n	y	n	n

Adapted from Harcourt Math

Appendix P



Appendix Q

Written Retelling Worksheet

How did you solve it?

Turn to page 148 in your math book and complete letters a., b., and c.

Explain how you solved the problem.

a. 8 x 11 =

b. 3 x 11 =

c. 4 x 10 =

Complete 10 and 11 on page 149. Tell how you solved the problems.

10. 88 ÷ 11 =

11. 90 ÷ 10 =

Appendix R

Group Interaction Interview Questions

What is each group member's responsibility?

What did you learn from _____?

What did you help to teach?

On a scale of 1-5, how well does your group work together?

Why?

What would make your group better?

Appendix S

Say Something Grid

Question	Connection
(1) I wonder how much money she makes in a year?	(3) I do chores but I dont get paid
Opinion	**Wow!**
(2) My opinion is the first expression matches the top.	(4) I have a lot more money than her.

Adapted from Borasi, Siegel, Fonzi, and Smith (1998)

Appendix T

Reaction Guide
Lesson 9.6

With your partner take turns reading and discussing each of the statements below. Put a check if you agree or disagree with each statement. Be sure to support your answer with at least one example. Turn to page 173 and use number 2 to help you answer these questions.

1. The table used multiplication to figure out what y is.

I agree_____ I disagree ✓ because I disagree Because the table used division

2. The table divides by nine each time.

I agree_____ I disagree ✓ because false Because 21÷3=7 and not 9

3. The table divides by seven each time.

I agree ✓ I disagree_____ because true Because 21÷3=7

4. The rule for this table would be x ÷ 7 = y.

I agree ✓ I disagree_____ because true Because the variabals are x and y and they are dividing by 7

Adapted from Wood (1992)

Appendix U

Math Autobiography II

Complete each sentence from your experiences in math this year so far.

My most positive math experience was. MultiPlaCation

Math makes me feel Not haPPY

I learn new math concepts by theother Years i learnea math.

In math, I am good at MuttiPlacation

If I were a math teacher, I would Not give any Bory homework And have a Party For the holoxay

The main point of reading a math book is to learn about Newstuff.

Solving word problems in math is easy/hard because You don't know what the Numbers are in the sentens

Words in a math book are important because You can learn Newthings.

Adapted from Vacca & Vacca (2005)

Appendix V

MILLIONS			THOUSANDS			ONES		