7-2007

A Study of the Role of Mnemonics in Learning Mathematics

Kathy DeLashmutt
Hastings, Nebraska

A Study of the Role of Mnemonics in Learning Mathematics

Kathy DeLashmutt
Hastings, Nebraska

Math in the Middle Institute Partnership
Action Research Project Report

in partial fulfillment of the MA Degree
Department of Education
University of Nebraska-Lincoln
July 2007

A Study of the Role of Mnemonics in Learning Mathematics

ABSTRACT

In this action research study of my fifth grade mathematics teaching, I investigated student engagement levels in the classroom, with a specific interest in the importance and effectiveness of mnemonics in learning mathematics for all learners. I defined mnemonic instruction as a strategy that provides a visual or verbal prompt for students who may have difficulty retaining information. It is a memory enhancing instructional strategy that involved teaching students to link new information that is taught to information they already know. I investigated mnemonics effectiveness in my classroom by using two student interviews, a teacher survey, two student surveys and student and teacher journals. I discovered that mnemonics works for some of my students and has become a useful tool in my classroom. As a result of this research, I plan to continue to use mnemonics not only in my mathematics class, but also in the teaching of other subject areas.

INTRODUCTION

The topic of inquiry for my research project is whether using mnemonics on a daily basis will increase my students' understanding and retention of key mathematical concepts. The purpose of this study is to determine if using mnemonics and connecting real-life meaning with mathematical concepts is best for my students. By using mnemonics in the classroom, will my students be able to retain information and use their understanding of math concepts to solve new math problems?

My current teaching practice uses mnemonics to introduce new mathematical concepts each day. The students and I sing or chant a rhyme that covers a new concept. We then go over examples of the concept and practice a few of problems. As a group, I answer any problems students still do not understand. If one student has a question, many others usually have that same question. We work a few more problems together and then end with study time to let students finish their homework assignment. Many of my students' parents or guardians do not have the math background or many work nights and are, therefore, unable to help students with their homework. So, giving students 15 minutes to work on their homework in class is very beneficial. I must decide to give them the time to practice at school or have them return the next day without their homework completed. I would much rather have them feel successful in school, than feel disappointed in themselves because they could not understand the assignment.

I want to know if by teaching my students mnemonics over a two-month period of time, my students are able to retain the key math concepts that I am teaching them in math. I want my students to understand the concepts and be able to communicate their knowledge with their peers. I tell my students to, "share the wisdom." A good mind is a waste if you do not share your knowledge with others. I want my students to think for themselves and be able to recall the

meanings of the math concepts by using mnemonics. The questions I have are: Is making connections to their world an aid in long-term memory of key math concepts? What will be the effect of mnemonic strategies on students' homework scores? To what degree will students' practice their mnemonic skills with their peers?

For my problem of practice I am wondering whether or not my students were making connections to key math concepts through the practice of mnemonics. Another thing I wonder about was whether mnemonics might assist them with mathematical learning. Students that practice mnemonics may retain the math concepts and be able to retrieve them at a later date. Will they be able to communicate these mnemonics techniques with fellow classmates in order to enhance learning and understanding of math concepts? Will all students use the strategy of mnemonics?

When I shared my ideas with other teachers, many were reluctant to try mnemonics in their classroom. When a few teachers tried just one of the mnemonic rhymes, they were surprised how quickly the kids memorized the concepts. Teachers are under a lot of pressure to have their students not only understand the concepts, but also be able to retain the information over a longer period of time. To me, this is what teaching is all about. With increased assessments and time restraints, teachers hope some students retain what is taught and are able to regurgitate the key concepts when it comes to assessment day.

Problem Statement

The reason mnemonics instruction is important is because it appears to be an effective strategy for increasing student comprehension test scores. On average, students who have been trained in mnemonic instruction outperform students without training on comprehensive exams. Mastropieri, Scruggs, Levin, Gaffney and McLoone (1985) suggest that the reason

comprehension scores are higher for students using mnemonic strategies was that the strategy increased their ability to recall the factual information needed to answer comprehension question. Through the use of mnemonic strategies, it is more likely that the students will be able to remember factual information, answer questions, and demonstrate comprehension. Students who need help understanding the concept will benefit from instruction in comprehensive strategies.

The reason educators should care about mnemonic instruction is because it is a strategy that provides a visual or verbal prompt for students who may have difficulty retaining information. It follows the premise that as children learn, they are building a web of knowledge. Students that make connections to the outside world will be able to retain the new information and connect the key concepts to their schoolwork.

Literature Review

"Learning something new is like adding a thread to a web. For students with memory challenges or processing disorders, a mnemonic device becomes a tool to build threads from new to old ideas" (American Institute for Research, 2004, p. 1). When teaching young children with disabilities, they need to have other tools in order for them to grasp the key concepts. I believe giving my students these tools helped them retain information and connect the concepts in other subject areas, such as language arts, science and math.

Mnemonic strategies were used in a general education setting by college undergraduates learning foreign language vocabulary (Scruggs & Mastropieri, 1989). Later research extended the use of such instruction into classrooms of younger students and among students with learning disabilities. In a recent study, college students used a mnemonic strategy to study and recall painting-to-artist matchings. All four experiments of the study repeatedly showed that those

students who used mnemonics substantially outperformed those who did not use them on tests that required recall of artists and their paintings (Carney & Levin, 1991). After reviewing the research from the four experiments, they proved that mnemonics was a definite aid in retention of factual information. Even though these studies did not include math, mnemonics was a key factor in retention.

Three Methods of Teaching Mnemonics

There are at least three distinct methods for teaching mnemonics: keyword, pegword, and letter strategies. The keyword strategy is based on linking new information to keywords that are already encoded to memory. According to Scruggs and Mastropieri (1989), the keyword strategy works best when the information to be learned is new to students. Wang and Thomas (2000) have shown that the initial benefits of using the key word mnemonic (an imagery-based technique designed to foster cued recall of paired associates) are not very durable over time when retention interval is manipulated as a between-participants variable. Whereas other studies (McDaniel & Pressley, 1987; Pressley, Levin & Delaney, 1982) with repeated-measures designs reported long-term benefits of the key word method. An example of keyword mnemonics that I used in my classroom was to remember the correct placement of the numerator and denominator. I presented a fraction using the variable N for the numerator and D for the denominator. I then told my students the top of a map is always North, so the top of all fractions is called the Numerator and the bottom variable (denominator) starts with a D, such as Dakota.

1	N	North	Numerator
4	D	Dakota	Denominator

Pegword strategy uses rhyming words to represent numbers or order. The rhyming words or “pegwords” provide visual images that can be associated with facts or events and can help

students associate the events with the number that rhymes with the pegword. Pegword mnemonics has proven useful in teaching students to remember ordered or numbered information (Scruggs & Mastropieri, 1989). The pegword example that I used in my classroom was for an improper fraction. My students were confused between a mixed numerals and an improper fraction. So, I presented a picture of a snow cone and told them that the upper part of a snow cone is bigger than the base of the cone, thus representing an improper fraction. This eliminated the confusion between the two terms.

Letter strategy involves the use of acronyms and acrostics. Acronyms are words whose individual letters can represent elements in lists of information. Acrostics are sentences whose first letters represent to-be-remembered information. Teachers can use these letter strategies to help students remember lists of information (Scruggs & Mastropieri 1989). Being able to make those connections by using letter strategies gives students another tool in order to retain the new key concepts they have learned. I use the following letter strategy or acronym in my classroom for the correct order of operations of an algebra problem. This example is posted on a poster on my wall for all my students to see.

P lease	P arentheses
E xcuse	E xponents
M y	M ultiplication
D ear	D ivision
A unt	A ddition
S ally	S ubtraction

Effectiveness

Mnemonics instruction is also an effective strategy for increasing student comprehension test scores in Language Arts and Science. On average, students who have been trained in

mnemonic instruction outperform students without training on comprehension exams. Researchers suggest the reason comprehension scores are higher for students who use mnemonic strategies is that the strategy increased their ability to recall the factual information needed to answer a typical comprehension question. Through the use of mnemonic strategies, it is more likely the students will be able to remember factual information, answer questions, and demonstrate comprehension. Students who need help understanding the concept will benefit from instruction in comprehension strategies (Mastropieri, Scruggs, Levin, Gaffney, & McLoone, 1985).

Mnemonic Devices

Mnemonic devices are of two main types: organization mnemonics and encoding mnemonics. Organizational mnemonics organize and interrelate new information in memory so information can be later recalled. Examples of organizational mnemonics are the method of loci, the pegword mnemonic, the story mnemonic, and the link mnemonic (Bellezza, 1981). The use of an encoding mnemonic is sometimes necessary before an organizational mnemonic can be used. Encoding mnemonics are used to transform low-imagery, abstract material into more memorable forms before an organizational mnemonic is used to store the information in memory. For example, an encoding mnemonic can be used to transform abstract words into high-imagery substitutes so that they can be stored more easily in memory. An abstract word, such as "fiscal," may be replaced by some semantic association, such as "money," or by words similar in pronunciation, such as "fish tail." It turns out that for most people the words "money" and "fish tail" are easier to process in memory because these words are familiar and high in imagery. "Later, when the substitute word 'money' or 'fish tail' is remembered, it acts as a cue for the related word 'fiscal,' and this latter word is recognized as the word that was to be

memorized" (Bellezza, 1981 p. 247). When I think of semantics, I usually associate it with language arts or writing. I now believe that semantics plays a key role in math as well. The example that I used in my classroom was for the definitions of mean, median and mode.

> mean – the **mean average** (adding all of the numbers together and divide by the number of values)
> median - the number in the **middle** of a list of values ranging from smallest to largest
> m**o**de - the number you see one or more times
> There once was a mean old average, and he had a median that was caught in the middle of a group of numbers, and some of the mode numbers he saw more than once.

> Technical mnemonic training may be more beneficial to populations who find it difficult to generate effective strategies (e.g., children, learning-disabled individuals, older adults). Similar students tested after a delay interval were significantly disadvantaged when compared to mnemonic training participants and to students who had generated their own strategies (Wang & Thomas, 2000, p. 338).

So, as students become more confident using mnemonics of their own, they will develop their own learning strategies. Having my students write their own mnemonics was more meaningful to them than the mnemonics that I sometimes created for them. I was amazed at the number of creative mnemonics my students generated.

Mnemonic Studies

> In this study, learning disabled junior-high school students learned the definitions of 14 vocabulary words according to a pictorial mnemonic strategy (keyword method) or via the principles of direct instruction. Results of the first experiment showed that when specially constructed mnemonic illustrations were provided, the keyword method was substantially more effective than direct instruction. The keyword method continued to surpass direct instruction in the second experiment, even when keyword students were

> required to generate their own mnemonic images. The potential benefits of mnemonic vocabulary instruction for learning disabled populations are considered (Mastropieri, Scruggs, Levin, Gaffney, & McLoone, 1985, p. 57).

Having learning disabled students in my classroom, I discovered that the keyword method was helpful with retention. (See Appendix B, in particular, questions 6 and 12.)

Long-term Effectiveness

It was difficult to judge whether my students were retaining the information for a long period of time. Assessing whether mnemonics was absorbed into my students' long-term memory would require more than two months. Some of my students were able to repeat some of the mnemonic phrases or poems we created in class after the two month period. It was hard to determine whether they comprehended the mnemonic or whether it was the repetition of going over the mnemonic phrases twice a week for a two month period of time.

Problems Concerning Mnemonic Devices

I was able to teach 1-2 math mnemonic phrases to my classroom for a period of two months. I tried to use as many senses as possible to encourage the use of mnemonics. I added music, color, pictures and gestures to increase all of the avenues that stimulate learning.

> Even though the use of mnemonic devices often results in remarkable levels of recall performance, mnemonic devices operate by the use of cognitive structures that, some what disturbingly, have little or no relation to the conceptual content of the material being learned (Bellezza, 1981, p. 247).

Some of the students were not paying attention or were not participating during my mnemonic presentation. It is hard to introduce a new mnemonic when some of the students are not willing to put toward the effort. Some of my students did not know the tunes that the mnemonic phrases

went along with. I then had to teach the folk song before I could teach the new mnemonics song, this would be another one of the weaknesses of mnemonic strategies.

I found a book entitled, *Mnemonic Songs for Content Area Learning*, (Goldish, 2006) which was very helpful. This book contained mnemonics for language arts, science, math and social studies. I found three examples for math using mnemonics (see Appendix I).

One of the biggest things that I have learned from this study and from my students (see Appendix C for student interviews) is that mnemonic instruction is an inexpensive strategy that helps average and resource children gain access to the general education curriculum. No specific level of teaching experience is required to learn or use this strategy. Teachers have to be very thrifty, so finding an inexpensive way to enhance your teaching is very valuable. Using mnemonic instruction involves no additional costs for purchase of materials or technology.

I believe mnemonics can be teacher created or student created. However, the teacher should introduce and create mnemonics until students learn how to properly use them. Students were encouraged to create their own mnemonics after plenty of practice using mnemonics, students created mnemonics with appropriate and correct information. This gave my students a real-life connection that will stay with them for a long time.

After reading all of the different literature, I was not able to find any mnemonic connections to mathematics. Bellezza (1981) had many studies that used music, reading and language arts to see if the students made connections with mnemonics. Were the students more successful than the students who did not use mnemonics? Bellezza was somewhat disturbed, his students had little or no relation to the conceptual content of the material being learned. Even though Bellezza used many mnemonic devices, he found students' test results were inconsistent. Even though they showed high levels of recall of the language arts material, they were not able

to connect what they had learned in their writing essays. McDaniel and Pressley (1987) taught a second-language vocabulary to grade school and college students by using pegword and keyword mnemonics. McDaniel and Pressley noticed that both grade level and college students showed mnemonics aided in their learning of a new language, but not at the levels that they would have thought. For any class that is taught, a teacher shows the students how to use many different ways to tackle a problem, but the students really cannot tell which one they used to find the solution or if they used one. Many of my students used more than one strategy to solve a given math problem.

My research will connect what I have learned from math mnemonics with other subject areas. This is a good starting point for me to obtain data from my surveys and interview in an area that has not been researched before. I have found mnemonics to be a useful tool for the diverse population in my classroom All of the research that I have obtained did not assess using mnemonics in math. Some of the mnemonic materials were especially designed for factual content. A keyword mnemonic illustration for learning math vocabulary is a way to enhance students' achievement of the definitions of new vocabulary , both native and foreign. Even though the mnemonics are simple I still had to be consistent and follow the same practice each time I reviewed the new mnemonic song or phrase. I could not deviate from the rhythm of the phrases or songs in order to be consistent over and over again. Some of my lower students would only be able to follow the mnemonics if I taught it exactly the same way each time.

Purpose Statement

The point of my project is to see if, through mnemonics, my students' homework scores and retention of mathematical concepts will increase over a long period of time. The purpose of

my project was to determine if using mnemonics with mathematical concepts was best for my students.

I am seeking to understand if my students' test scores will increase due to mnemonic strategies. I will interview 10 of my students before and after teaching mnemonics. I will see if my students practice and share their mnemonic skills with their peers. My students will keep individual journals and share their insights about mnemonics. I will also see if my students' long-term memory of key concepts will increase. I will have my students fill-out two surveys to see if their answers change over a two-month period of time. I will look at four of their homework assignments and then pick out three students (low, middle, high) and compare their assignment scores with the rest of my fifth grade class.

In May, I gave out 15 teacher surveys, to see if mnemonics were used in their teaching. I also wanted to know their feelings about math before and after they started teaching. In the survey, the teachers will be asked about their comfort zone in teaching math concepts.

I will be examining the variables of: assessments, long-term memory (retention), keyword mnemonics, and improvement of vocabulary in seeking to answer the research questions.

1- What will be the effect of mnemonic strategies on students' test scores?

2- To what degree will students practice and share their mnemonic skills with peers?

3- What will be the effect of mnemonics on students' longer-term memory of key concepts?

Method

During my study, I decided that mnemonics was a key ingredient for my teaching. I wanted to see if by using mnemonics each day for a two-month period of time, my students'

retention of math concepts would increase, stay the same, or drop. I interviewed 10 of my students before and after my teaching of mnemonic phrases and visual aids.

The data that I collected was from many different resources. My first source was from 18 individual surveys my students were asked to fill-out on February 14th, 2007. The first six questions were setup on a 1 – 5 scale, with 1 as "rarely occurred" and 5 as "always occurred." Then my students were asked to write their responses for #7 – 14. Each question had to do with their understandings of math concepts, homework, and the use of mnemonics in the classroom and on daily homework. Students were interviewed. I interviewed 10 of my students one-on-one at the beginning of March 2 and then again on March 29th. I had talked to a colleague and she had said she had conducted a few of her students' interviews and she didn't know if they were giving her the answers they thought the teacher wanted to hear or if they were giving their honest opinions. After hearing this, I decided to have her conduct half of my 10 students' interviews and then I would compare them with the five interviews that I conducted.

I organized my data by using tables and then tabulated the results in a table (see Appendix C). I would list the question and then write down their responses. When I had two forms of data to compare, (see Appendix C) I wrote the first data on the first line and then the second entry on the second line. I then grouped my students' data into 6 categories I then looked at 14 of my students' homework, and picked out the lowest, middle and highest test scores. By looking at these test scores, I was able to see if using mnemonics was helping or hindering their grades. The three students that I chose were low (Nan[1]), middle (Len) and highest (Ian) students in my classroom, based on their homework assignments (see Appendix A). I then graphed four of their homework grades (April 4, 11, 18, and 25) and averaged them together. I then averaged all three students' grades from each homework assignment to see how they compared to the

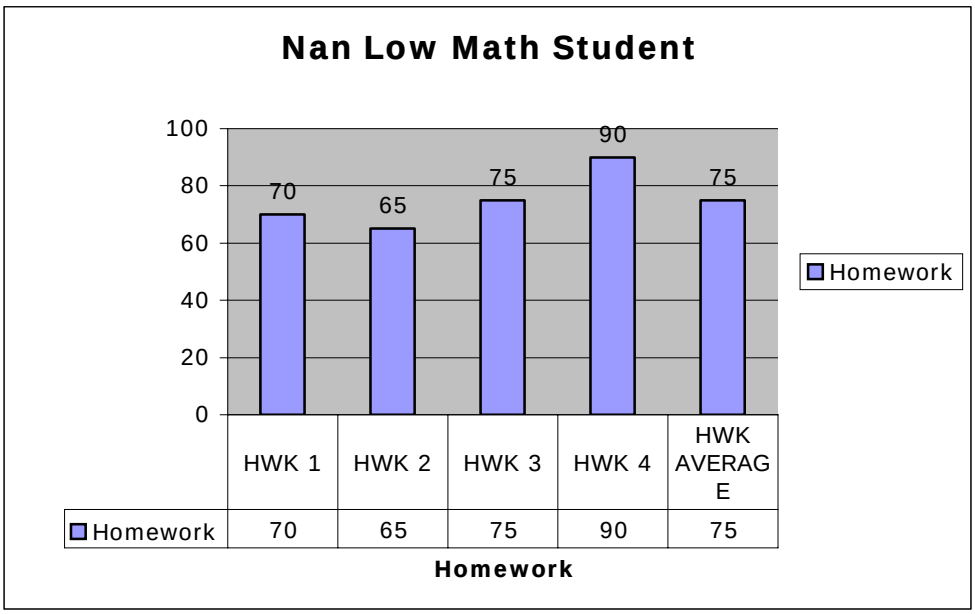
[1] All names are pseudonyms.

classroom's average. I was making a comparison between the whole class and the three individual students on whether mnemonics helped my students on their homework assignments.

Findings

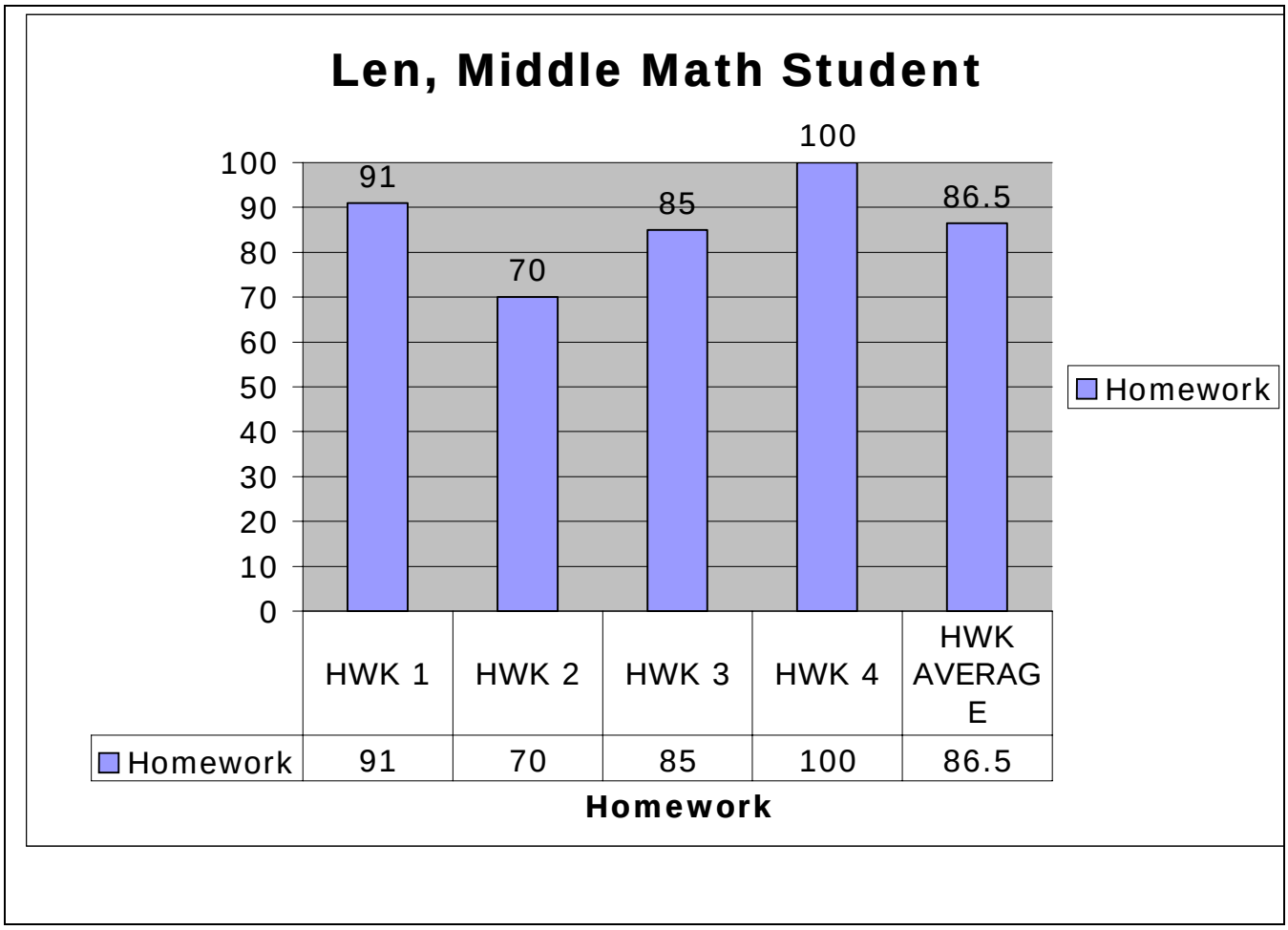
During the month of April, I collected four homework assignments (April 4, 11, 18, 25). Appendix A shows all of my fifth grade students' four homework assignments. I wanted to show all of my classes' homework assignments, so I could discover who were the low, middle and high student in my math class. The three I chose are in bold print.

Following each of the charts, I describe three students and a little background knowledge about each one. Each student is unique and I wanted to show three examples of the diverse population I have in my classroom.



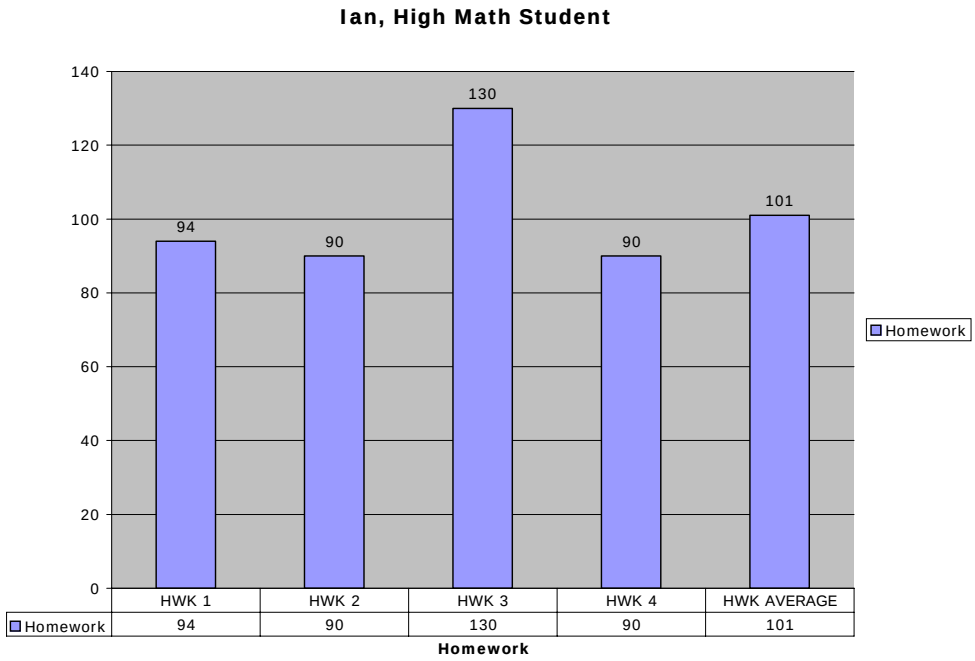
Nan, is one of my low math students. She had just come from Spain in February. However, English is her first and only language. Her Math skills are rather low and she is trying to fit in to the American school system as best as she can. Her basic math skills are lower than most of my

fifth graders. I chose 4 of Nan's homework assignments from April 4, 11, 18, and 25th. These

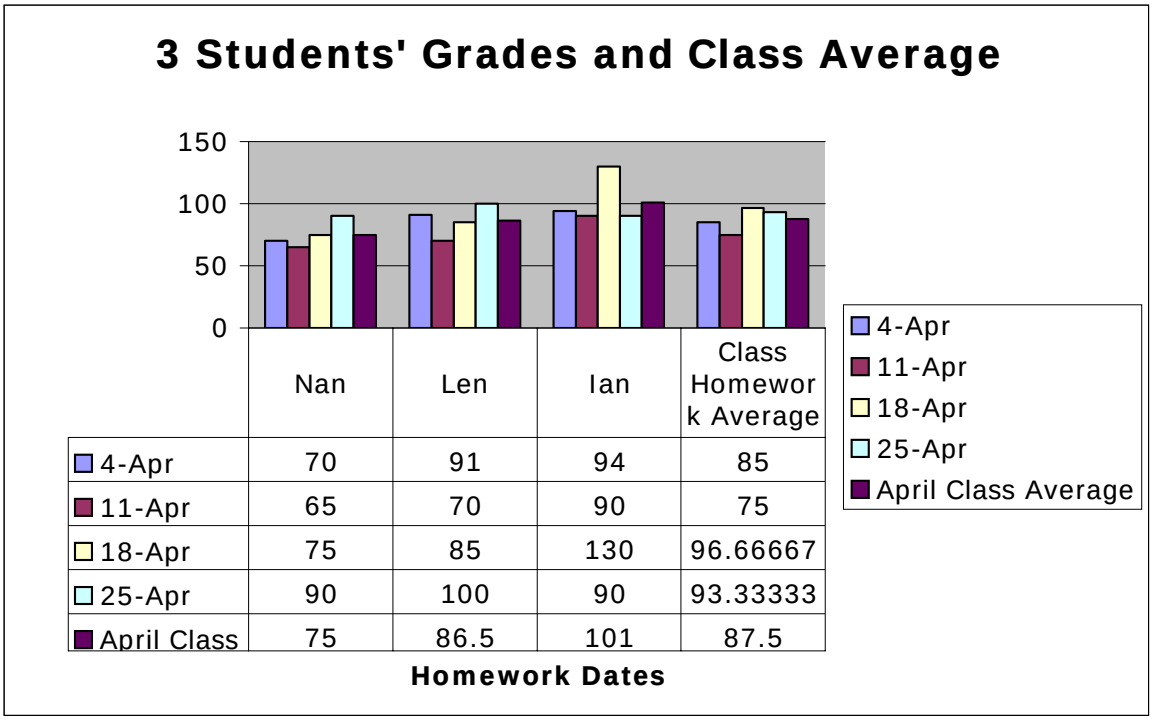


homework assignments consisted of the end of our division unit and the first three weeks of fractions. Her homework average after 4 assignments was a 75%, which you can see in the right column.

Len, is one of my middle math students. He has been in my classroom all year long. He has great math skills, but his behavior gets in the way of his progress. I chose four of Len's homework assignments from April 4, 11, 18, and 25th. These homework assignments consisted of the end of our division unit and the first three weeks of fractions. His homework average after four assignments was a 86.5%, which you can see on the right column.



Ian is one of my high students. He has been in my classroom all year long. He has great math skills, but his shyness (from being new this year to our school) tends to restrain him from sharing his wisdom with his peers. I chose four of Ian's homework assignments from April 4, 11, 18, and 25th. These homework assignments consisted of the end of our division unit and the first three weeks of fractions. His homework average after four assignments was a 101%, which you can see on the right column. Ian has very high grades, because he double checks his work and always exceeds my expectations, especially when given the option of bonus points. As one can see, the 130% was because Ian did 15 extra problems to boost his score to a 130%.



	Nan	Len	Ian	Class Homework Average
4-Apr	70	91	94	85
11-Apr	65	70	90	75
18-Apr	75	85	130	96.66667
25-Apr	90	100	90	93.33333
April Class	75	86.5	101	87.5

This is a chart of all four students, their four homework grades, and the last column shows the averages from each of the homework assignments. I thought this would be a good comparison to see all four students and their averages. From this graph, I can see that Len's grades had improved over the month of April. Nan's grades tend to stay the same during the month of April. Ian's grades stayed consistent throughout April.

The following are the two interviews that two of my colleagues and myself administered to ten of my fifth grade students on March 2 and 29, 2007 (See Appendix C). After talking to my colleague, she thought that some of her students gave her the answers to her interview questions that were not their true opinions. They were giving her the answers that they thought she wanted to hear. They did not want to hurt her feelings and make her feel that she was a bad teacher. So, I decided to have my colleague give half of my first interviews and I would give the other five of the interviews. After comparing the results, I feel that my students were giving both

of us their true opinions about the questions. I believe my students were consistent in their interviews, no matter who the interviewer was.

I decided to pick 9 out of the 13 questions to respond to the first question in Appendix C after interviewing my students. I was surprised that all responded to the first question saying that they liked math this year. I was very glad to see such a love for math from all of my students. Question two was about how much time they were working on homework, on average, per night (see Appendix C). I was surprised that most of my students were working less than 35 minutes per night on homework. I would have thought it would have been much higher. I was surprised by student, Sue, that her first answer was 15 minutes and now her answer is two hours. I did not know she was working on homework that long. When I asked her mother, she responded, "She works on homework about two hours each night, which includes all subjects, not just math homework." Of the ten students that were surveyed, three had stated that they worked 15-20 minutes per night on homework, five stated that they worked 25-35 minutes and two worked 40-50 minutes per night, when given the survey on March 2, 2007. When given the same question on March 29, their responses included two students who said 15-20 minutes, seven students who said 25-35 minutes and one student, Sue, who changed her answer from five minutes to two hours per night. In my classroom, we go over the previous homework assignment for 10 minutes and they may ask any questions that they had trouble answering and then they hand in their homework. I then teach 20 minutes on the lesson of the day and give them 20-30 minutes to work on their homework assignments or to ask questions. So, very few of my students should have problems to complete at home. If they use their study time wisely, they should not have homework.

In Appendix C, question 3 asked, Do you like to present your homework on the chalkboard? Their responses to this question included six who said they like to share their work because it helped other students. One student responded, “Yes, I like to do homework on the chalkboard because you find out if your answer is right or wrong.” Two of my students stated “No, I didn’t like to do homework on the chalkboard because if I get it wrong, I will get embarrassed.” I have two shy little girls from Mexico, but even they are excellent math students. They have a hard time explaining their solutions to the problems. This might be why they get embarrassed in front of their peers. We have really used sharing their work on the board as a learning tactic rather than as a critique of being right or wrong. Some students were embarrassed at first, but by the end of the first quarter, they learned from others’ mistakes or learned a new way to solve the same problem. I told them, “You probably have the same questions or make the same small error as other kids in class. This is a learning project, we are all here to learn may different ways to approach the same problem. If you can show someone else an easier way to get the same solution, great!” Many of my students are making the same mistakes and it is good to see them express their answers on the board and then have someone else tell them, “Hey, I did that too.” Students use the overhead projector to show work. I never thought much about using the overhead until one student asked “if he could write his solution on the overhead.” I responded, “Absolutely.” As we interviewed the students again, I was glad to see that seven out of the ten liked to share their answers and to help others. Two agreed and wanted to find out if their answer was right or wrong. Only one student responded that she was too shy.

In Appendix C, question 4, I was surprised by students’ responses to the question, “What are the benefits of presenting your results on the chalkboard?” Six out of 10 responded, “that by showing your work, it helps others.” Three responded, “it was easier to understand,” and one

student said that he was getting smarter and when he showed his solution to the class, it made it easier to explain how to do it. They are becoming great peer models and are so willing to share their wisdom with others. They are getting more confident in their math and it does make it easier if they know what they are doing. Their next responses on 3-29-07 were very similar to the previous answers. They enjoyed helping others and it was easier to explain their answers.

In Appendix C, question 7, was, do mnemonic keywords help you in remembering key concepts? Eight out often students said, "Yes, in division, fractions and multiplication." One said, "No." When given the same question on March 29, three stated "yes," two said" no" and two didn't remember. Two students changed their answer and said, they used it to solve story problems. I responded, "Marvelous." I think that mnemonics is helping half of my students, so I am happy with the results. If I am seeing 50% of my students improve due to mnemonics, I feel very successful.

In Appendix C, question 9 states, "Has your attitude about working math problems changed during the fifth grade year?" I was surprised how they are learning so much this year. I have learned so much from this class. They are opening up their minds and really thinking outside the box. I see evidence of this when I see responses like the following: "I learned more, I understand it more, I like it more, it makes all my work worthwhile."

In Appendix C, question 10 shows 100% of my students stated that "this year math was easier because Mrs. DeLashmutt shows it first then I get the hang of it." Also, "Mrs. DeLashmutt helps you and it's like a game. It's fun!" "She makes it easier and she goes over it with us and she makes up rhymes to make it easier to learn math." I believe fifth grade math is very tough. We are taking basic concepts and really turning them up a notch. We are also introducing many concepts they are never seen before, especially with fractions and story problems. My students

have added fractions before, but now we are talking about how to get common denominators, multiplying and dividing fractions. When you divide a fraction, they learn the word reciprocal, a brand new concept. My class has been exposed to many math concepts that I never felt comfortable teaching until this year.

On May 9th, I gave out 14 teacher surveys to my colleagues. These consisted of two teachers from each grade Kindergarten to 6th grade and one ELL teacher. Of the 14 teachers, 13 surveys were returned. The only teacher who did not respond was out on maternity leave. Since my topic was on mnemonics, I did not think every teacher would know what mnemonics was, so I put a sample of some phrases from a book I found in Scholastic. "*Mnemonic Songs for Content Area Learning.*" I ran off a couple on colored paper and attached it to each survey. They were so kind and responded in two days. I love to cook and they were all happy to do it. One teacher said, "I would have filled out the survey without the dessert, but I am so glad you are cooking for us." I was very impressed with the overwhelming response from my colleagues. This is a very busy time for teachers and they were so courteous toward my math program.

In Appendix D, question 1, I have six of the 12 responses from my colleagues at school. I chose these questions because I could input their responses in five or six columns. My first question was, "Do you enjoy teaching math this year, why or why not?" Nine of the teachers said, "Yes, I enjoy teaching math and the challenges of teaching students." Also, "I enjoy teaching with manipulatives and hands-on materials." "Yes, I like to teach math, but I'm always teaching ELL language. This year I am teaching new third graders math." The negative responses came from four of the teachers. Their responses were "no, to assessment driven, not enough time to cover everything." "No, Kindergarten does not have a real book, must find everything on my own." So, nine out of 13 teachers enjoy teaching math while four out of 13

teachers have a burden of assessments and lack of curriculum that puts a damper on their enjoyment of teaching math.

Appendix D, question 2 asked, “How much time on average do you spend on Math in your classroom on a daily basis?” Two teachers responded 20-30 minutes. Seven said 40-45 minutes and four said 50-60 minutes. The people who responded 20-30 minutes caught my attention. In our district, we are to be teaching math for 40-50 minutes per day. This is half of what is expected.

In Appendix D, question #7 states what mnemonic phrases or techniques do you use in your teaching? Two responded, “Can’t think of any?” Two used the planets’ order in science to aid in the proper order of the planets. Four had used them when teaching multiplication or division, such as divide, multiply, subtract, bring down. Two said, “they used mnemonics in science Language Arts, and spelling by using rhymes, songs, picture clues, chants and poetry.” “PEMDAS- which is order of operations that we use in Math. P-please E – excuse M-my D-Dear A-Aunt S-Sally. And BASMO to remember the southern provinces of South America.” The two kindergarten teachers responded “simple ones for writing letters, 5-down, around, put a hat on top and using nursery rhymes and other chants to remember the presidents.” Wow! I am glad to see that 11 out of 13 of my colleagues are using some form of mnemonics in their classroom. Hopefully, after this study, I will find more mnemonics to share with my colleagues.

In Appendix D, question 9, “Do you share your mnemonic skills with other teachers that are not in your building? Seven stated “yes” and 6 stated “No or had no answer was given.” As teachers, we tend to incorporate our great ideas into our curriculum but do not have time to share them with other colleagues. I hope to see that change in the future. We are going to have learning team meetings every Wednesday from 3:45-5:00 next year. These learning teams consist of 8

teachers from each grade, Kindergarten through sixth grade, that teach in the Hastings Public School System. I am looking forward to these learning team meetings. This will be a valuable time to exchange and share ideas.

In Appendix D, question 10, states “Was Math difficult or easy for you in elementary school?” Six said, “Challenging or difficult, especially in high school.” Six said, “Easy.” and one said, “Hard, wasn’t ready to learn.” One of the teachers said that she was very sick in fifth grade and the missed two weeks of school. When she returned to school, she had missed out on the fraction unit. She was struggling when she was trying to make up the homework assignments and the teacher said, “Too bad, I don’t have time to go back and teach that again, so she failed that quarters math.” How sad, that a teacher would not give a little extra time to help catch up a student. The last question was #12 and states “How do you as a teacher, help students feel more comfortable about Math?” Eight out of 13 said, “Make it fun and challenging, by using games and hands-on activities, and manipulatives.” By focusing on success even when learning is difficult. Be able to re-explain things over and over in different ways. Teach in smaller groups and one-on-one, if needed. Also, start with what they know and expand on their background knowledge. Peer teaching is a very powerful tool.

CONCLUSIONS

My findings suggest that mnemonics helps many students, but not all of them. Some of the students would rather just learn the math concepts, instead of having to learn a form of mnemonics to remember the concepts. I noticed that some of my lower students used the mnemonics to help retain key math concepts. I also used mnemonics in other classes to help some of my students help retain science and language arts concepts.

My students are living proof that if you give them the encouragement, confidence and proper mnemonics that they can achieve great thing. My students were excited about math and have had many opportunities to broaden their math horizons and look outside the box when doing many of the problem of the day story problems. They are looking for keywords in story problems and are able to decipher what information they need and can disregard.

Many of the problems that I had with students in the past were die to lack of interest and dedication to increasing their math knowledge. My students needed to feel more confident about their math knowledge and be willing to share the wisdom with their peers. Sharing one's wisdom with others makes one very powerful. If you do not share what you know with others, you are just being greedy. Many of the students in my Math in the Middle class have expressed they are taking more time to have the students brainstorm and share their ideas or solutions to a problem in front of the class. Classroom participation is very important and should be used in every classroom. It is a very powerful tool.

The scholarly literature does support the importance of making connections with one's students. When I was looking for research in the math area while using mnemonics, I could not find any. Math is one of the subject areas that limited mnemonics research has been done in.. Researchers suggest that the reason comprehension scores are higher for students using mnemonic strategies is that the strategy increased students' ability to recall the factual information needed to answer a topical comprehension question. Through the use of mnemonic strategies, it is more likely that students will be able to remember factual information, answer questions, and demonstrate comprehension. Students who need help understanding the concept will benefit from instruction in comprehension strategies (Mastropieri, Scruggs, Levin, Gaffney, McLoone, 1985). Mnemonics is a memory enhancing instructional strategy that involves

teaching students to link new information that is taught to information they already know. According to Levin (1993) mnemonic instruction is useful for students across a wide age range. “Teachers instruct students in the use of mnemonic strategies by using both visual and verbal cues” (American Institute of Research, 2004, p. 1).

IMPLICATIONS

As a result of my study on mnemonics, I will be taking the following actions. I will continue to use mnemonics in my classroom. I will find more mnemonic phrases or chants that would help make connections between key concepts to my students. My students enjoyed mnemonics in math, so I will find other mnemonic phrases to use in other subject areas. I feel that my students benefited by using mnemonics and wanted to know when we would be using them in language arts, science and writing class.

After reading my students’ surveys, I am impressed with their love for math and their willingness to enhance their math abilities and there willingness to share their wisdom with other fifth grade classrooms and their siblings. Many of my students were encouraged to use mnemonics in and outside of the classroom. In the future, I will make a bulletin board with mnemonic phrases and chants that were successful this year. Hopefully, we will continue to add to this list for future references. I foresee that I will have a long list if this year’s class was any indication of what is to come.

REFERENCES

American Institute For Research. (2004). Access center improving outcomes for all students K-8, U.S. *Ideas that work,* Office of Special Education Program.

Bellezza, F. (1981). Mnemonic devices classification, characteristics and criteria. *Review of Education Research,* 51(2), 247-275.

Carney, R. & Levin, J. (1991). Mnemonic facilitation of artists and their paintings: Effects of familiarity and correspondence. *Contemporary Educational Psychology,* 16, 154-170.

Hwang, Y., & Levin, J. (2002). Examination of middle-school students' independent use of a complex mnemonic system. *The Journal of Experimentation Education,* 71, (1), 25-38.

Goldish, M. (2006). *Memory-boosting mnemonic songs for content area learning*. Scholastic Inc.: New York, New York.

Levin, J. (1993). Mnemonic strategies and classroom learning: a twenty-year report card. *Elementary School Journal, 94*(2), 235-244

Mastropieri, M., Scruggs, T., Levin, J., Gaffney, & McLoone, B, (1985). Mnemonic vocabulary instruction for learning disabled students. *Learning Disability Quarterly, 8*(1), 57-63.

McDaniel,M. & Pressley, M. (1987). *Imagery and related mnemonic processes, theories, individual differences, and applications.* New York: Springer-Verlag.

Pressley, M., Levin, J., & Delaney. (1982). The mnemonic keyword method, *Review of Educational Research, 52*(1), 61-91.

Scruggs,T. & Mastropieri, M. (1989). Mnemonic instruction of LD students: A field-based evaluation, *Learning Disability Quarterly*, *12*(2), 119-125.

Wang, T., (2000). Looking for long-term mnemonic effects on serial recall: The legacy of simonides, The American Journal of Psychology, *113*(3), 331-340.

APPENDIX A

Name	# Corresp.	4/4/07	4/11/07	4/18/07	4/25/07	Individual Average
Jd	1	76	90	85	80	82.75
As	2	82	100	112	100	98.5
Ka	3	79	100	118	100	99.25
Rn	4	73	100	85	100	89.5
Mn	**5**	**70**	**65**	**75**	**90**	**75**
Sa	6	61	100	65	80	76.5
Je	7	73	100	107	100	95
Pn	8	76	70	119	80	86.25
Tr	9	88	100	99	100	96.75
Jn	10	75	80	70	90	78.75
Dl	11	86	100	100	100	96.5
Ky	**12**	**91**	**70**	**85**	**100**	**86.5**
Jk	**13**	**94**	**90**	**130**	**90**	**101**
Cy	14	94	100	85	100	94.75
In	15	82	80	90	100	88
Class Average		80	89.6666667	95	94	89.66666667

Fifth Grade Math Class during the month of April, 2007.

From the above chart, I found the low, middle and high math students in my classroom.

APPENDIX B

18 student surveys,. First one given on 2-14-07 and the second on 5-1-07. 17 surveys were completed on both dates.

Results from Student Survey (rounded to nearest whole number + or -1%)

1. I like math.	1-rare	2	3	4	5-always
given 2-14-07	1/17 – 6%	0/17 – 0%	0/17 – 0%	7/17 – 41%	9/17 – 53%
given 5-1-07	0/17 – 0%	1/17 – 6%	3/17 – 17%	7/17 –41%	6/17 – 36%

2. I am good at math.	1-rare	2	3	4	5-always
given 2-14	1/17 – 6%	0/17 – 0%	5/17 – 29%	6/17 – 36%	5/17 – 29%
given 5-1-07	0/17 – 0%	3/17 – 17%	4/17 – 24%	6/17 – 36%	4/17 – 24%

3. Mnemonics is important.	1-rare	2	3	4	5-always
given 2-14	2/17– 12%	0/17 – 0%	3/17 – 17%	2/17 – 12%	10/17-59%
given 5-1-07	2/17 –12%	0/17 – 0%	3/17 – 17%	5/17 – 29%	7/17 - 41%

4. I use mnemonics often.	1-rare	2	3	4	5-always
given 2-14	2/17 – 12%	1/17 – 6%	3/17 – 17%	2/17 – 12%	9/17 – 53%
given 5-1-07	4/17 – 24%	3/17 – 17%	7/17 – 41%	2/17 – 12%	1/17 – 6%

5. I feel it is important to use mnemonics to remember key vocabulary words.	1-rare	2	3	4	5-always
given 2-14	1/17 – 6%	0/17 – 0%	2/17 12%	3/17 – 17%	11/17-65%
given 5-1-07	0/17 – 0%	0/17 – 0%	0/17 –0%	7/17 – 41%	10/17-59%

6. My grades improve when I use mnemonics.	1-rare	2	3	4	5-always	
given 2-14	1/17 – 6%	1/17 – 6%	2/17 – 12%	6/17 – 36%	7/17 – 41%	
given 5-1-07	0/17 – 0%	0/17 – 0%	2/17 – 12%	9/17 – 53%	6/17 – 36%	
7. This is my favorite math concept and why?	multiplication I'm good at it and it is easy.	division fun and easy	fractions,	no answer	addition	story problems
given 2-14	11	2	0	0	3	1
given 5-1-07	8	2	5	2	0	0

12. My teacher feels it is important to use mnemonics in math because	it helps me remember key concepts makes it easier	figure out the meanings of words	fun and helps you learn more	get better	no answer
given 2-14	8	1	3	2	3
given 5-1-07	10	1	3	1	2

13. Is there a time when you should not use mnemonics and if so, when?	if you don't know how to use them	no	when you already know the answer	if it interrupts other people	yeah, if you're camping or reading	when working on hard problem or dividing
given 2-14	1	10	1	1	2	2
given 5-1-07	3	6	2	1	1	4

APPENDIX C

The following are the two interviews that my two colleagues and myself gave 10 of my fifth grade students on March 2 and 29, 2007,

1. Do you enjoy Math this year?	yes	no			
given 3-2-07	10				
given3-29-07	10				

2. How much time on average, do you spend on homework assignments?	15-20 min	25-35 min	40-50 min	55-60 min	2 hours
given 3-2-07	3	5	2		
given3-29-07	2	7			1

3. Do you like to present your homework on the chalkboard?	yes, share your work and help others	yes, find out if your answer is right or wrong	no, if it is wrong, I get embarrassed	no, I'm shy	
given 3-2-07	6	1	2	1	
given3-29-07	7	2		1	

4. what are the benefits of presenting your problems on the board?	show your work and help others	easier to understand	get smarter and show the class, easier to explain how to do it		
given 3-2-07	6	3	1		
given3-29-07	7	2	1		

7. Do mnemonic keywords help you in remembering key concepts?	yes, in division	yes, in fractions	yes, in multiplication 56=7x8	yes, 8 x 8 on the floor, playing nintendo 64	no	don't remember	solve story problems
given 3-2-07	2	2	3	1	1	1	
given3-29-07	1	1	1		3	2	2

9. Has your attitude about working math problems changed during the fifth grade year?	no	a little	I'm getting better	yes, I have learned more	I understand it more	I like it more
given 3-2-07	2	1	2	5		
given3-29-07				1	4	5

10. What makes Math difficult or easy for you?	easier, because Mrs. DeLashmutt shows it first then I get the hang of it	easier, because I know some mnemonics and my multiplication facts	easier, because the teacher goes over it with us and we can ask questions. I understand it better.	easier, Mrs. DeLashmutt helps you and it's like a game. It's fun.	easier, because I learned what the words mean. Nothing difficult.	easier, she goes over it with us and she makes up rhymes to make it easier to learn math concepts	easier now, because I have worked harder and studied harder to learn math this year.
given 3-2-07	3	1	1	1	1	1	1
given3-29-07	4		3			3	

10B What could teachers do to help students feels more comfortable about Math?	I don't know	use more mnemonics	help us get it, talk to us about it show us how to remember problems	show more mnemonics	use mnemonics- it helps a lot	teach them more and make them do it right	nothing- just right	work 1-on-1, in pairs, and in group
3-2-07	2	2	1	1	1	1	2	
3-29-07	1	2	2					5
5	1	2	2					5

APPENDIX D

Teacher Interview Surveys given May 9, 2007 to 14 teachers. 13 surveys returned.

1. Do you enjoy teaching math this year, why or why not?	yes, I enjoy teaching math this year and the challenges of teaching students.	yes, I enjoy teaching with manipulatives and hands on materials	yes, I like to do teach math but always teaching ELL language. Teaching new 3rd graders math this year.	no, to assessment driven, not enough time to cover everything	No, Kindergarten does have a real book, must find everything on my own.
	6	2	1	3	1

2. How much time on average do you spend on Math in your classroom on a daily basis?	20-30 minutes	40-45 min	50-60		
	2	7	4		

7. What mnemonic phrases or techniques do you use in your teachng?	can't think of any right now	use in science, planet order and other science concepts	songs about multiplication or division (ex. divide, multiply, subtract, bring down	Math, Science, L.A, and Spelling rhymes, songs, picture clues, chants, poetry	PEMDAS, Homes=5 great lakes, BASMO-southern provinces of South America	simple ones for writing letters 5-down, around, put a hat on	addition say 3 plus 3 equal 6
	2	2	4	2	1	1	1

9. Do you share your mnemonic skills with other teachers that are not in your building?	yes, with other teachings. Shared quantum learning stuff.	yes, order of operations Please Excuse My Dear Aunt Sally	no	No answer
	6	1	3	3

10. Was Math difficult or easy for you in elementary school?	challenging in elementary hard in high school	difficult	easy	hard, wasn't ready to learn
	3	3	6	1

12.	make it fun and challenging	games and hands-on activities	present it many different ways manipulatives and variety of activities	focus on success even when learning is difficult	re-explain things over and over in different ways, in smaller groups and one	start with what they know and expand on it. peer

					on one if needed	teaching
	2	2	4	1	3	1

APPENDIX E

Survey Questions					
Please give your honest response to each statement, on a scale from 1-5, 1 means rarely and 5 means always.					
Please circle one answer for each statement below.					
1. I like math.	1	2	3	4	5
2. I am good at math.	1	2	3	4	5
3. Mnemonics is important.	1	2	3	4	5
4. I use mnemonics often.	1	2	3	4	5
5. I feel it is important to use mnemonics to remember key vocabulary words.	1	2	3	4	5
6. My grades improve when I use mnemonics.	1	2	3	4	5

COMPLETE THE FOLLOWING STATEMENTS.

7. This is my favorite math concept and why?

8. One good thing that happened in math is:

9. One not so good thing that happened in math is:

10. What I wish my math teacher knew about me is:

11. I feel that showing your work is important because….

12. My teacher feels it is important to use mnemonics in math because…

13. Is there a time when you should not use mnemonics and if so, when?

14. I do not like to use mnemonics because….

APPENDIX F

5B Student's name_____ Date _____

Given by _____
(A few examples of mnemonic phrases are enclosed).

Student Interview Questions

1. Do you enjoy Math this year?

2. How much time on average, do you spend on homework assignments?

3. Do you like doing homework presentations on the chalkboard? Why or why not?

4. What are the benefits of presenting your problems on the board?

5. How successful do you feel about using Math skills you have learned in class, outside of class? Give and example of a Math concept you used in another class, such as, Science, Reading, etc?

6. Why is it important to know the meanings of vocabulary words you see in Math?

7. Do mnemonic keywords help you in remembering key concepts?

8. Do you share your mnemonic skills with other students that are not in your Math class? What mnemonics have you shared with other students?

9. Has your attitude about working math problems changed during your fifth grade year?

10. What makes Math difficult or easy for you?

Have you ever had a really bad experience with Math? If so, what happened?

What could teachers do to help students feel more comfortable about Math?

11. Had you ever used mnemonics before this year? If so, what were they?

12. Is there anything you want to know about me?

13. Is there anything else I should know about you to better understand your problems in Math or your general Math experience?

APPENDIX G

Name _____

Date 5-9-07
(A few examples of mnemonic phrases are enclosed).

Teacher Interview Questions

1. Do you enjoy teaching Math this year, why or why not?

2. How much time, on average, do you spend on Math in your classroom on a daily basis?

3. Do your students present some of their homework on the chalkboard, to share with their peers? Why or why not?

4. What are the benefits of presenting their work on the board?

5. How successful do you feel about using Math skills you have learned in and outside of class, in your classroom? Give and example of a Math concept you used in another class, such as, Science, Reading, etc?

6. Why is it important for students to know the meanings of vocabulary words you present in Math?

7. What mnemonic phrases or techniques do you use in your teaching?

8. What mnemonic keywords help your students retain key concepts?

9. Do you share your mnemonic skills with other teachers that are not in your building? What mnemonics have you shared with other teachers?

10. Was Math difficult or easy for you in elementary school? Explain.

11. Have you ever had a really bad experience with Math? If so, what happened?

12. How do you as a teacher, help students feel more comfortable about Math?

13. Had you ever used mnemonics before this year? If so, what were they?

14. Is there anything else I should know about you to better understand your problems in Math or your general Math experience?

APPENDIX I Multiplication Facts (sung to “Down by the Station”)

Multiplication,
Multiplication numbers,
A quick way to count!
Choose any number,
Then choose another
Multiply the numbers
To find the amount.

Numbers 1 to 10
When multiplied by 6 are
6, 12, 18, 24, 30, 36,
42, 48, 54, and 60.
Multiples of 6 increase very quick!

Numbers 1 to 10
When multiplied by 2 are
2, 4, 6, 8, 10 and 12,
14, 16, 18, and 20.
Multiples of 2 are oh, so swell!

Numbers 1 to 10
When multiplied by 7 are
7, 14, 21, 28, 35,
42, 49, 56, 63, 70.
Multiples of 7 really come alive!

Numbers 1 to 10
When multiplied by 3 are
3, 6, 9, 12, 15, 18, 21,
24, 27, and then 30.
Multiples of 3 are extremely fun!

Numbers 1 to 10
When multiplied by 8 are
8, 16, 24, 32, 40, 48
56, 64, 72, and 80
Multiples of 8 are truly great!

Numbers 1 to 10
When multiplied by 4 are
4, 8, 12, 16, 20, 24,
28, 32, 36, and 40.
Multiples of 4 are numbers
to adore!

Numbers 1 to 10
When multiplied by 9 are
9, 19, 27, 36, 45
54, 63, 72, 81 and 90.
Multiples of 9 really come alive!

Numbers 1 to 10
When multiplied by 5 are
5, 10, 15, 20, 25
30, 35, 40, 45, and 50.
Multiples of 5 really come alive!

Numbers 1 to 10
When multiplied by 10 are
10, 20, 30, 40, 50, 60 and
70, 80, 90, and finally 100.
Multiples of 10 are truly grand!

P. 68 MULTIPLICATION MNEMONICS

Fractions (sung to “When the Saints Go Marching In”)

Oh, when a pizza's cut in half,
Oh, when a pizza's cut in half
There are equal parts for two people,
When a pizza's cut in half.

Oh, when a pizza's cut in thirds,
Oh, when a pizza's cut in thirds,
There are equal parts for three people,
When a pizza's cut in thirds.

Oh, when a pizza's cut in fourths,
Oh, when a pizza's cut in fourths,
There are equal parts for four people,
When a pizza's cut in fourths.

Oh, when a pizza's cut in fifths,
Oh, when a pizza's cut in fifths,
There are equal parts for five people,
When a pizza's cut in fifths.

Oh, when a pizza's cut in sixths,
Oh, when a pizza's cut in sixths
There are equal parts for six people,
When a pizza's cut in sixths.

P. 71 FRACTIONS

Decimal Point (sung to "Mary Had a Little Lamb")
Chorus:
Some numbers have a decimal point,
Decimal point, decimal point.
Some numbers have a decimal point
To show amounts in tenths.

2.1 is two and one tenth.
4.6 is four and six tenths.
8.8 is eight and eight tenths.
The decimal shows the tenths.
Chorus
p. 72 DECIMAL POINTS

0.3 is three tenths
0.5 is five tenths.
0.7 is seven tenths.
The decimal shows the tenths.
Chorus

3.0 is three and no tenths,
6.0 is six and no tenths.
9.0 is nine and no tenths.
The decimal shows the tenths
Chorus