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Abstract

In this action research study of my classroom of sixth grade mathematics, I investigated word problems. I discovered that my students did not like to try word problems because they did not understand what was being asked of them. My students also saw no reason for solving word problems or in having the ability to solve them. I used word problems that covered topics that were familiar to the students and that covered the skills necessary at the sixth grade level. I wanted to deepen their understanding of math and its importance. By having my students journal to me about the steps that they had taken along the way to solve the word problem I was able to see where confusion occurred. Consequently I was able to help clarify where my students made mistakes. Also, through writing down the steps taken, students did see more clearly where their errors took place. Each time that my students wrote their explanations to the steps that they used in solving the word problems they did solved them more easily. As I observed my students they took more time in writing their explanations and did not look at it as such a difficult task anymore.
Our school is located in a rural setting, and the building that we are in is six years old. Most of the people in our community come from homes where both parents work in blue-collar types of employment. Our school is comprised of three grades: six, seven and eight. This year each grade level had approximately 300 students in it. All of our students are placed on teams in the building. Each team has a diverse population taking into account their ability level and gender. There were approximately 100 students per team. We have three learning pods in our building with three teams located in each pod. Each pod is made up of a separate grade. There were approximately 952 students who attended our middle school that year. Of those 952 students, 80% were Caucasian/white non Hispanic, 2.31% were receiving English Language Learning (ELL) services and 44.18% of the total school population was on free and reduced lunch. We are considered a middle school and have operated as such for 10 years. Previous to that time the sixth grade students were in the grade schools in our town. We currently have seven K-5 grade schools in our district that send children to our building. In our town we also have a private Catholic school that is K-12 and a private K-8 Lutheran school.

I have always taught in this school district. My first year of teaching was at the sixth grade level, and I was responsible for teaching all of the disciplines. The next year, I taught K-6 physical education and then the following three years I taught all subjects in a fifth grade classroom. When the middle school was formed I transferred to the middle school, and I have taught math at the sixth grade level for the past 10 years.

The topic of my inquiry was mathematical word problems. I chose this topic because I noticed that my students would either skip word problems or put little effort into solving them. When I would mention that we were going to solve word problems in math class, they would groan as if I had asked them to eat their vegetables. This was bothersome to me because I
enjoyed solving word problems as a child, and I felt such satisfaction when I did so. This skill of problem solving has been a very valuable skill over the years, and I want my students to leave sixth grade with this skill and the confidence to solve word problems or real problems that they encounter in life. If my students could feel this sense of accomplishment when solving word problems it would be wonderful.

I began my inquiry as to why these students did not care for word problems or did not try to solve them. Most of the comments had to do with the fact that they found the word problems confusing and they were not sure what they were being asked to solve. They did not have the skills to pull out information that was not necessary. My students also had a preconceived attitude that the word problems solved problems that had nothing to do with them or anything that they would need to solve in the future. The word problems that were part of our math series dealt with topics that many of my students knew nothing about. My students gave me many topics that they felt would interest them and make them more willing to solve the word problem.

The materials available with our Holt Course Two textbook were limited on word problems. Many of the topics used in the word problems were not interesting to sixth graders. The word problems were usually at the end of the page on a worksheet and were looked upon as challenge problems. When the students saw the word challenge in front of a problem they immediately felt defeated. I will have to supplement our district material with my own word problems and worksheets.

**Problem Statement**

The issue of teaching that I considered for my research was the issue of word problems and students’ lack of enthusiasm in solving word problems. My question was if the students were
taught a step-by-step method of solving word problems, would this increase their expertise and enthusiasm?

Before my research, in my classroom the minute the students saw a story problem on a worksheet or in their book, they would run right up and ask for help before they even had looked at the problem carefully. Many times they just wrote some answer down so that they could say that their homework was finished. The next day when we corrected the assignment and talked about the problems my students rarely asked how to solve the word problem. When we discussed the steps to solve a word problem the students did not seem very interested at all. I explained to them that this was just like learning the steps to a mathematical equation. I asked my students why they did not like word problems and my students told me that the problems take too long to solve.

According to National Council of Teachers of Mathematics (NCTM, 2000) standards, teachers need to make sure that students can solve word problems and use problem-solving skills to solve math problems. The tests that our district uses to report to the state are called Criterion Reference Tests (CRT). I know that in our district’s CRT results, word problems and estimating are the two areas that on which our students have not scored as well as we would like them to. The math department spends one day in the fall disaggregating the data from our CRT results from the previous year. We can look at our scores by ethnic background, gender, free or reduced lunch and other way that we would like to view the data. At this time we develop some interventions for our students that are designed to help them perform better in these weak areas.

The students’ dislike of word problems bothers me because solving word problems is a very important skill to have. I am also bothered by this because I love solving word problems, and I took great pride in solving word problems when I was in school. I know that if I can find a
way for the students to learn to solve the word problems and feel good about it they will enjoy
math more and score better on the required tests. I really want the students to do well on word
problems because they will experience similar real-life problems.

My ideal classroom for this issue would be students who like math but not word
problems. At least the students would have the basics down and I would just need to concentrate
on the teaching by analyzing the word problem. I want them to see how much fun word problems
can be and how they will help them to better understand the math concepts that they have been
taught up to this point.

After visiting with my classmates in Math in the Middle and other math teachers, I know
that this feeling about word problems that I am seeing in my classroom is not unique to my
classroom. Through my research I hope to find ways to help my students see the importance and
the fun of solving word problems and real-life problems. I hope to show them some tools that
will help them solve problems. Once we see the benefit in my classroom I would be more than
happy to share this with my colleagues. Actually if things go well, my students would be the
ones that could share with others how to successfully solve word problems. My hope is that they
will in turn share this with others out in the community.

**Literature Review**

Word problems can be such a valuable learning tool once one is able to get away from
the stigma that the term “word problem” brings with it. The topic of my project was to make
sense of word problems. When my students feel good about themselves and the fact that they
have learned a new math skill through the use of word problems, I will have met my goal. In
reading research related to this topic, four basic themes appeared. First and foremost, the concept
that teachers needed to change the way that they taught word problems; sometimes this could be
as simple as changing the structure of the word problems themselves. Second, students should be encouraged to draw pictures and doodle as they solved the problem. Third, making a connection of the word problems to the children’s lives made the learning more meaningful and lasting for them. Fourth, the students should be tested before the skill was taught and after learning the skill to see how the teaching affected the learning of the students.

**Changing the Teaching Strategies**

In reading research about word problems and how they were taught, all of the articles that I read made some mention of the fact that the approach that teachers have taken in the past for teaching this skill needed to change. Okoka (2004) had four steps to successfully teach word problems and have them make sense to the students. The steps were very simple but effective. First, use cooperative groups when solving the word problems. Second, allow students enough time to act out and work out problem solutions. Third, encourage students to reflect on the reasonableness of their answers. Fourth, accept alternative solutions. Okoka did her study by actually going into the sixth grade classroom and teaching one hour a day, five days a week for one month. She used her method of teaching word problems as mentioned earlier.

The teacher’s opinion of word problems and their usefulness in teaching mathematics played a huge role in the success of the students. Many teachers felt that math word problems were much more difficult to solve than a regular equation-type math problem (Koedinger & Nathan, 2004). Koedinger and Nathan did their research with 76 students from an urban high school. Eighteen of these students were ninth graders, the rest were eighth graders. Teachers also had the opinion that word problems that contained a skill should not be introduced until the skill had been learned through numerous math equations covering this skill.
Depaepe, De Corte, and Verschaffel (2007) studied 206 sixth grade students and 10 teachers to observe if the climate in the classroom affected how students attempted to solve word problems. What these researchers discovered was that when the teacher engaged in questioning the students and the students’ methods of solving the word problems, the students performed much better. The textbook that this district was using at the time encouraged group work to solve word problems; however, the researchers did not see this strategy of teaching used very often.

Good instruction is taking place in the mathematics classrooms but some vital aspects are missing. According to Depaepe, De Corte, and Verschaffel (2007), praising students, exploring, modeling, and scaffolding were strategies that were lacking in the classroom. According to Xin (2007) fundamental mathematics needed to be taught by using problem-solving opportunities that emphasized mathematical thinking. Xin did a study of 54 Chinese students and 57 U.S. students that were in the lower 25% of their class and members of the sixth, seventh and eighth grade classes. She chose lower-achieving students because they struggled at all levels of problem solving. The Chinese students in this study scored higher on the word-problem tests administered than the U.S. students did. The textbooks in the U.S. used word problems with consistent language most of the time. If the language changed and the students could not follow their normal pattern then they missed the problem. In the Chinese textbooks inconsistent language-type problems were used often. This study suggested that teachers needed to write their own story problems and teach the students how to translate what was being said in the word problem into what was being asked of them to solve. This will help the students to think mathematically.

As a teacher, in my past instruction, I used word problems as extra credit or challenge problems, and I did not use such problems to their fullest potential. I now use word problems in
all stages of teaching, reinforcing, and testing a new skill. My students are coming up with their
own word problems to help one another study for quizzes or exams.

Many math textbooks had word problems on worksheets that were called challenge sheets. When students saw the word “challenge” this raised their level of concern and not necessarily in a positive way. By transferring these word problems to worksheets without this title the students were more likely to attempt the word problem. On regular worksheets the word problems were usually at the end of the worksheet after the student has done several equation-type problems with the same skill in mind. Many times the kids would choose not to even try them or they would just jot some answer down. What was even worse was they did not even make the connection that they are to use the skill previously learned as an equation to solve the word problems.

*Connecting the Word Problems to Real World Situations*

Connecting a child’s classroom learning to real-life situations is a great teaching strategy but it is especially helpful in the teaching of math skills and word problems. If teachers can connect a math word problem to something that the student uses in their lives then it takes on a whole new importance to the students. Of the nine articles that I read on word problems, six of them mentioned that making this real-life connection was vital to the children understanding the math concept as well as being able to perform the skill. Fractions were a difficult topic for sixth grade students to comprehend but it was a mastery standard in our district. Darby (2008) made reference to the fact that using fruit was a great way to make the connection in algebra of adding like terms. Darby interviewed six secondary math/science instructors in Australia. I found this example to be a great way to show fractions. It worked out very well in my classroom. The
students used the different kinds of fruit to show fractions of the entire bowl of fruit. After this lesson, the students had a much better grasp of the concept, and they got to eat the display.

Giving the students a tool or strategy to use to solve a word problem was part of the focus of the study done by Depaepe, DeCorte, and Verschaffel (2007). They wanted the students to make a mental picture of the problem, decide how to solve it, do the math, then make sure that they understood the answer that they came up with, and finally then decide whether their answer actually made sense. They wanted the students to be taught in such a manner that using these strategies would be so natural to them they would become better problem solvers. The importance of connecting the math in their textbooks to real-life situations also was observed. In the classes where real-world connections were made to the mathematics being taught, the students scored significantly higher on their post-test than the students who did not make those connections.

Both Darby (2008) and Depaepe, DeCorte and Verschaffel (2007) emphasized the importance of making real-world connections with classroom learning. However, Darby (2008) did not do any pre- or post-tests to show where learning had occurred or where there was a difference. She also wanted instructors to use stories from the teacher’s own experiences in the world to be used to make the connection. Depaepe, De Corte and Verschaffel (2007) did pre- and post-testing of the students to show the change in their learning. They also wanted the teachers to change the way that they interacted with the students in response to the students’ attempts to solve a word problem. They wanted the teachers to help the students to make the connection rather than making it a teacher connection.
Pre- and Post-Testing Of Word Problem Skills

Showing growth is important to the educator as well as to the student. The easiest way to show this is by pre- and post-testing. Students are amazed in the spring when they get measured for the second time in the sixth grade and they see how much they have grown. They are also surprised when they run the mile in the spring because they have become faster, and they did not feel as worn out as they had in the fall. These are ways that our students are accustomed to experiencing pre- and post-testing. I discovered the value of pre- and post-testing in my classroom this year. At the beginning of each new skill I had my students take a pre-test and they were usually not very happy with their score. Now, I had my students hooked and they were ready to do what it took to improve their pre-test score. At the end of the unit my students took the post-test, and they were so excited to see how much that their knowledge had increased. My students charted the pre- and post-test scores side by side so they had a visual reminder of how much their hard work paid off.

Kercood (2007) studied eight fourth and fifth grade students that had been labeled as having learning problems or attention problems but had not been officially diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). In this study the students were given a pre-test of word problems. Then they were given the word-problem test but allowed to have tactile stimulation during the test. Half of the students did perform better on the second test and attempted more problems when they had the stimulation.

In a study with a larger number of teachers as participants the pre- and post-test proved to be very helpful. The study by Depaepe, DeCorte and Venschaffel (2007) showed no real significant difference in the two groups on the pre-test results. This allowed them to feel comfortable about having both groups at a similar ability to start with. After the intervention they
were post-tested. Even though the participants did not score as high as the researchers had hoped, the experimental group did score significantly higher than the control group. Without the pre-test results they may not have known how significant the increase was and, even more importantly, how well matched the groups were before the intervention.

All of the groups in this section used pre- and post-testing to see the impact of their studies. Kercood, Grskivic, Lee and Emmert (2007) only studied eight students. Rule and Hallagn (2006) studied 42 elementary teachers and Depaepe, DeCorte and Venschaffel (2007) studied 206 students. The pre- and post-testing was important no matter the size of the group being studied.

Student Solutions

Students should be able to represent their solutions in a number of ways to help them express their understanding of a skill or concept. I stressed to my students that I wanted to see the method that they used to solve a problem so that if there was an error I could help them. Better yet I wanted to see their solution, so that the other students, or I, could see another way of looking at a problem. Throughout my research, I came across this idea many times. For instance Foley, Parmar, and Cawley (2004) gave numerous ideas on how to allow students with learning disabilities to express their solutions to problems that did not require reading or writing. The Foley, Parmar, and Cawley article was written as part of a grant from the U.S. Department of Education, Office of Special Education and Rehabilitative Services. This article was extremely helpful to me as part of my quest to make word problems more enjoyable and useful to students that have low English-language ability or reading ability.

“Learning how to be a problem solver is an even more empowering skill.” (Foley, Parmar, and Cawley, 2004, p.15). I wanted all of my students to feel empowered but especially
those kids who had not ever felt empowered about anything. Word problems can be developed by simply putting up a series of pictures on a board and asking the students to come up with a word problem to go along with the pictures that have been represented (Foley, Parmar, and Cawley). Allowing students to come up with projects to show a math topic is an amazing way to show understanding. Students can be given choices so that the final project is their decision. Some choices could be to make up a song, poem, story, drawing or 3D example of a math skill from start to finish. Letting kids draw their own solution to a word problem they are asked to solve also is very empowering to the students.

Students need to be allowed to solve problems using charts, graphs, pictures or words. (Koedinger, 2004). As long as the students get the correct solution to the problem and the process is mathematically sound we should be pleased as educators. Foley, Parmar, and Cawley(2004); Andersson (2006); Darby, Depaepe, DeCorte, and Verschaffel (2007); Kercood, Grskivic, Lee and Emmert (2007); Okoka(2004); Xin(2007); and Koedinger and Nathan(2004) made reference to many ways in which problems could be solved by the students or presented to the students. The authors also agreed that there could be more than one solution to real-world problems and that we as educators need to be open to this concept.

Conclusion

In the research that I read, I was very excited to see that there seemed to be a common thread. The fact that teachers needed to change the way in which they taught and presented math word problems made me analyze the way in which I taught. I had been guilty of using word problems as challenge assignments or making them extra credit. Now I look at word problems as a wonderful way to teach each math skill my students and I are responsible for. I have always been a teacher who would accept more than one way to do something; so, when I read this over
and over again in the literature, it just reinforced this aspect of my teaching philosophy. I have
not always been very good about connecting my students’ learning to their real world or to their
interests. This is an aspect of my teaching that I am currently working on to improve so that my
students can claim more ownership to their learning. Not all of the articles that I read had this as
a main point, but it was brought up enough that I felt that it was important to my research. I
currently do pre and post-testing as I mentioned earlier so this was another aspect of my teaching
that has been reinforced by the research that I have done.

My project is different from the research that I have read about because it concentrates on
sixth grade math students only. My research is also tied directly to the standards that my sixth
graders are responsible for in our district and these are directly linked to NCTM standards. Kook
(2004) was the only author I read who mentioned NCTM standards, and that was only as a
passing comment. My project is also unique in that it can be picked up by any other sixth grade
teacher in our district and used right away. Teachers at other grade levels can also use it with a
few minor modifications.

**Purpose Statement**

The purpose of my study was to determine what happened when a systematic way of
solving word problems and using formative assessment to assist in the student understanding of
the math skills used in the word problems was implemented. The controlled variables in my
project were the word problems that I provided for my students as part of their homework. I also
provided the word problems that were used in their journals. My measured variables in this
project were the pre- and post-test results and the pre- and post-survey results.

The questions guiding this research are:
• What will happen to the students’ abilities to successfully solve word problems when the students are taught the language of word problems and how to interpret it?

• What will happen to the students’ understanding of word problems when the students are taught math vocabulary and ways to express what these words mean? (such as pictures, graphs, charts, tables, number sentences and equations)

• What will happen to the way that I teach word problems after I observe the way that my students explain the word problem-solving process in their journals?

**Method**

As part of my research I kept a teacher journal. At first the comments were about me and how I was preparing for the research. I made my first entry on December 29, 2008. This was well before the project started. I had students who were going to need letters in Spanish so I had to find someone in the district that could do the translating for me. I knew that this would take some time so I started early. I wrote a great deal at first on procedural things that I was doing to prepare for the project. As the project progressed I wrote more about my observations of my students and how they were performing. Then, I wrote more about what my students were saying and interacting with one another. Writing about how my students were interacting with others was extremely helpful to me. I could hear what their thoughts were and if they were grasping the concepts correctly. I had 44 entries in my journal for the entire project.

All of the students knew that I would be doing a project because their parents had to give their permission. What they did not know was when I was actually doing the project and when I was just doing the normal sixth grade teaching. When I started on my project I wanted the actual project to be very much a part of the normal day and curriculum so that I was sure that my students would not do anything out of the ordinary just because it was part of my project. I
wanted a true reading on how they felt about word problems, and I wanted to be able to see what learning truly was taking place.

On February 17, 2009, I started my data collection with a simple six-question survey (Appendix A) about word problems. Then, over the course of the next week, February 17-23, I interviewed the 33 students in my first core math class. I interviewed them at lunch time in groups of four or five. I used a digital recorder that was very small and this did not seem to inhibit them at all as I asked and they answered the questions. I asked the students questions individually in another part of the room and then for the word problem I brought the group together. I did this because otherwise the subsequent students would have time to work on the word problem while they waited their turn and I would not get a true representation of what they did and did not know how to do. I had two young ladies who were gone from school a great deal so this delayed my interviewing. I finally finished on February 23, 2009. A copy of the interview questions and problem can be found in Appendix B.

I administered a pre-test on February 23 (Appendix C), which consisted of all word problems. This was a 33 word-question test that had topics that my students had been exposed to as well as ones that had not yet been covered in class. They were given one hour to complete the test and instructed to show all of their work as usual. I also instructed them to finish as many as they possibly could in the amount of time given. The next school day after the test they were asked to journal about the test and how they felt when they were taking it or after it was over. My purpose of using a pre-test was to give me a baseline to measure any growth that may take place due to my interventions.

I introduced journals as a place for students to write down the word problem and then solve it right there. They were asked to do the calculations as well as explain each step to me. I
have shown the students the grading rubric that will be used on their journals (Appendix D). The first day or two I was not impressed by the quality of work being shown in the journals. I spoke to the students about this on March 5. On March 10, I taped a copy of the rubric to the inside of each student’s journal.

Once my students had the grading rubric to refer to they seemed to pay more attention to what they were writing. During my data collection we had influenza A and B go through the school. On average I had 20 students a day gone for a two-week period. This made it difficult to get all of the journals graded and discussed with the students in a timely fashion.

On April 4, I tried a new way to review using word problems. Since I had not done it this way before so I was a little worried as to how this would all turn out. I had my teacher helpers from the eighth grade cut apart sheets of word problems that I had chosen. They put a set of all of the questions into eight stacks on the counter by a number 1-8. The numbers represented the tables that my students sit at. Each table group became a cooperative team. These tables of students are heterogeneously mixed. When I said go, they went to the counter picked up one of the questions and a piece of tape. Each table had a spiral notebook in the middle of it. They taped their question on to the page of the notebook. Then they all worked together to solve the word problem. They had to show all of their work and when I collected them each person was responsible for being able to answer any question and explain all of the steps that their team took to solve the word problem. When they completed the question, one person would go back to the counter, choose another question, bring it back to the table and start the entire process again. This went on until time ran out or they had answered all of the questions in the stack. At the end of class I collected the notebooks. I asked questions to the teams from various problems and if
they could not answer the question then they were docked one point. The teams would receive one point for each question that they correctly answered and had work shown for.

On April 7, we discussed in class how difficult it is to write good word problems. We discussed some things that could possibly take place as the person was writing or reading the problem. Then, I had the students write a word problem and have someone else in the class read it and try to solve it. We discussed each writer’s problem and the solver’s answer or attempt.

I collected journal entries about 22 times from February 4 to April 27. Some of the entries were just writing to me about how they felt about some of the problems that I had asked them to solve. Other entries were about word problems I had given them to solve and they included a step-by-step solution to the problem. This journal became very valuable to me as the project went on.

On April 22, my students took the post-test. This was the same test that they took as the pre-test on February 23 (Appendix B). My students were excited about taking the post-test. They had one hour to complete the test just as before. I also reminded my students to show all of their work.

On April 27, I gave my students the post-project survey. It was the same six-question survey that I had given them on February 17. The data chart shows the responses for the pre- and post-survey as well as the pre- and post-test scores (Appendix E).

On the pre- and post-test I calculated the percent of change in score from the first test to the second test. This can be found on the data chart in Appendix E. All of my data was placed in a folder with the student’s name on it after I used the data to calculate change and standard deviation. I had the entire journal writing in notebooks again with the child’s name on it. These were also placed in the folder. All of my folders were then placed in a crate with wheels on it.
Findings

A typical day for me began when I arrived at school between 7:00 and 7:30 a.m. I taught a reading class first thing in the morning for one hour. Then our students went to their explore classes (physical education, art, keyboarding, music, and family and consumer science). While my students were at their explore classes, we had our team meeting, plan time parent meetings, and staff development time. We also met with the guidance counselor or anyone else who felt that they needed to meet with us during this time. When the students returned I taught a sixth grade advanced math class, had snack time, goal setting and “Channel One.” “Channel One” was a news program for kids that was broadcast for about 12-15 minutes each day. This class period was 75 minutes long because of all of the other items that were taken care of at this time, other than teaching math. I usually left school around 4, went home, and recharged for the next day.

Prior to my project my students would check the marker board outside of my room for supply reminders. Then they would come in and sit down in the classroom at their table. The table groups in our classroom were made up of students of both genders and varying ability levels. The students would watch “Channel One” and eat their snack. Upon the conclusion of “Channel One,” we would have a quick discussion about the news program.

My students would get out their homework from the night before. Then each student would have one last chance to look it over before we would correct it in class together. After the assignment had been corrected, then we would discuss any questions that students had. The students would put their grade on the paper and hand it in to the graded paper drawer. I would write the goal for the day on the board and a warm-up problem that pertained to previously learned skills. My students would write these two items in their notes and begin solving the warm-up problem. After a few minutes we would discuss the warm-up problem and I would ask
for volunteers to take their work to the ELMO for display and explanation. After the warm-up is completed correctly and all questions had been answered about it, I would have the students hypothesize about what the goal for the day meant. Next, I would lecture and the students would take notes about the goal. We would do problems together and then individually. When I felt that the students were ready, I would assign 10-15 problems on the topic we discussed. These problems would be at varying degrees of difficulty.

During my project the first part of class was the same as far as snack and “Channel One” time. Actually the entire class was very similar for the first two weeks of my project. As I began to see the importance of the journals and the feedback that I was giving, the classroom procedures changed. After snack and “Channel One” time, I would ask my students if they had any vocabulary questions that they had encountered in their homework. Then, I allowed my students to make adjustments to their homework after getting those questions answered. We would correct the assignments together. However, now we would answer questions as we corrected rather than waiting until the entire paper had been corrected. After the homework was handed in the class would discuss the goal for the day. I would write the vocabulary words that I felt that my students may have difficulty with that day on the ELMO tablet. As a group we would come up with accurate, acceptable definitions for these words. The words were then placed on the word wall next to the math problem-solving area. I would write a math problem on the board and then solve it using the new vocabulary when necessary. Then I would put up another word problem and the students would solve it at their tables together. Before my students began working independently, I would ask them if they saw any vocabulary in the homework that could cause them problems. As a class we would discuss any troublesome words, add them to the word wall and the students would begin their assignment.
Starting on week four of the project until the end, things were changed just a little bit. On the days when I would introduce a new skill, I would assign one word problem in the students’ journals. They would be asked to explain step by step how to do the problem and then provide their solution as well. I would grade this using the rubric that I had designed (Appendix D). I found that if I had my students explain step by step and solve only one problem the first day, that I was able to catch and correct many mistakes. This way the students did not do 10 problems using an incorrect method. The next day I would hand back the journals right after “Channel One” and they could see the comments that I had made. We would have a great group discussion and then I would assign both word problems and numerical problems for the students’ homework that evening. On the second day of instruction on the same skill, my students would have problems assigned to them out of the book or from a worksheet. Usually no more than 10 problems would be assigned.

The first research question I investigated was: What will happen to the students’ abilities to successfully solve word problems when the students are taught the language of word problems and how to interpret it? My students were able to solve more word problems correctly after they had been taught the appropriate vocabulary. To start out my project, I had interviewed and surveyed my students. Then, on Friday, February 21, 2009, my students took a 33 word-problem test. Some of the vocabulary words were familiar to my students, and some were not.

The Monday following the test, I asked my students to tell me in their journal what they thought of the math word-problem test that they took. Betty1 mentioned in her journal on February 24, 2009, “I didn’t finish the test but I think it went well. I even think it was kinda easy.” Betty got 13 out of the 27 that she answered correct. Betty tested at the eighth grade reading level when we did our reading evaluation, at the beginning of the school year. She did

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1 All names are pseudonyms.
not mention either in her journal on February 24 or on the test that she did not understand the questions. However, she did skip questions so I asked her why and she said “I skipped the ones that I did not understand what they were asking me to do.”

Cathy also got 13 correct but she only attempted 24 questions. She did not mention on the test that she did not get what was being asked. Cathy’s journal entry for February 24, 2009: “I think that some of the problems were difficult because it was sometimes hard to figure out what they wanted me to do. I also got frustrated because I didn’t finish it.” Micky’s comment in his journal about the test: “It was average. I didn’t like all of them being story problems. I didn’t no (sic) some of the vocab. It was very tricky!” He scored 16 correct and answered all 33 questions in the amount of time that was given. Micky and Cathy are also in the top reading groups that we have on our team. Samantha attempted 14 questions on the test and got six correct. Her journal entry after the test: “I thought that the test was really hard. I didn’t finish it. It was a very frustrating test.” When I asked her why it was so frustrating she said: “Mrs. Ronhovde, I did not understand what the questions were asking me to do.” After reading my students’ journal entries and speaking to the students in class, the general opinion from them was that if the students understood the question they would at least try it. If the students did not understand a word being used in the problem they were unable to try it. They did not know where to begin.

At the beginning of my research, I gave a survey to see what my students’ thoughts were before we began this journey together. The first statement on my survey (Appendix A) was, “It is important to understand the vocabulary words in math before performing the skill.” The student could choose between the numbers one to five depending on their degree of agreeing or disagreeing with the survey question. Of the 31 students who had consented for me to use their data, the mean response on question one was 4.58 on a five-point scale and the standard
deviation was 0.86. This data was important because it showed that on average the 31 students felt that understanding math vocabulary was important in solving word problems. Previous to this survey, all year long in my classroom my students had heard time and time again how important vocabulary words and understanding of these words were in all subject areas.

When I saw the results of this question I was not surprised because vocabulary had been stressed in my classroom and in all of the other subjects’ classrooms on my team. In both the student journals and the interviews there were a number of comments about not being able to solve word problems because they did not understand the question that was being asked or a term in the question. In my classroom we not only discuss the meaning of vocabulary words but we also discuss how some words in math can have more than one meaning or action when making and solving an equation. An example of this would be: one day in class we were trying to set up an equation about the difference in temperature from the high and low temperatures of the previous day. We had discussed earlier in the year how the word difference means that we need to subtract. When they tried to set up an equation to solve this problem they were not having much success. Then we discussed that this was a difference in change and that in this case you actually end up using addition.

On April 3, we did a project in the classroom that required group work. The students had to get a problem, tape it into their notebooks and solve it as a group. Everyone in the group had to be able to explain the answer or the group would be docked points. Sam’s group got the answer to a problem similar to the change in temperature problem. Sam did not understand how they got that answer. He stopped the group and made them explain it to him. This is an excerpt from my journal on April 3:
“Wait how did you get that?” Sam asked. Cory: “Follow as I read the problem. Now do you see? Where did we lose you?” Cory reads the problem out loud again and as he is reading Sam stops him. Sam: “Stop, that is the part, what do they mean by the difference? I thought that we should subtract and you are adding. Why?” Brandy: “Here look at a number line. Does this help?” Sam: “Yes!”

Cory got the problem that was similar to this one correct on both the pre- and post-test. Brandy got the question wrong on the pre-test but solved the problem correctly on the post-test. She learned from what Cory was telling Sam and it was just enough that she figured out the error that she had been making when she took the pre-test. I felt that my students were more able to solve word problems after they worked together to analyze the word problems.

During the course of my project, I could see in my students’ journals that my students were more able to read a word problem and know what was being asked of them. My students were able to read all of the words that were there and then piece by piece decide what was being asked of them and what information they needed to solve the question. Jake is a high-achieving student and did a wonderful job of going through the steps of solving a problem. Then, Jake also started explaining the steps to check his work. This was a big step for him as he did not like checking his work because he could do so much in his head. In the post interview I asked Isaak how his attitude about working work problems changed during this year. His response: “The first test I did not like them a lot but now they are getting pretty easier.” The post-interview questions can be seen in Appendix F.

All of my students had a two-question or better increase in the number of correct answers in their post-test (33 items total). For the 31 students tested the average increase in correct answers was 9.5 questions. According to Xin (2007) fundamental mathematics needed to be
taught by using problem-solving opportunities that emphasized mathematical thinking. In Xin’s study she compared U.S. students that had been diagnosed with a learning disability and Chinese students that were in the bottom 25% of their class, on their ability to solve word problems of varying degrees of difficulty. The Chinese students scored better on the test than the United States’ students did. Then she looked at the design of the word problems in the United States and Chinese textbooks. Xin discovered that the problems in the Chinese textbooks were more difficult and varied the language to allow their students to use critical thinking to solve the math problem. This researcher suggests that teachers need to write their own word problems in the United States in order to give their students the opportunity to use more of their critical thinking skills. The current textbooks that are available to the United States teachers are not adequately written to provide higher-level thinking when it comes to solving word problems. This will help the students to think mathematically rather than just memorizing something that was told to them. The findings in my project go along with the information that I found in my research on vocabulary and solving word problems correctly. If the vocabulary in a word problem meant something different than the basic meaning, many of my students were not able to make that transfer of knowledge without practice.

The second research question I investigated was: What will happen to the students’ understanding of word problems when the students are taught math vocabulary and representations to express what these words mean? (Such as pictures, graphs, charts, tables, number sentences and equations). When I showed my students other methods of solving word problems, such as using charts, graphs, and tables, and how to convert that information into an equation, then they were able to solve word problems more effectively.
Before I gave my students the very first word problem in their journal on the 25th of February, we discussed other word problems and began to solve the problems without numbers at first. When I say that my students solved the problems without numbers, I mean that they used charts, graphs or pictures. Then I assigned the following problem to my students: You have three pizzas. There are nine students. If each pizza is sliced into sixths, how many slices would each student receive if the slices are shared evenly?

Hue drew three pizzas, divided them into sixths and then he also drew nine people. Hue then drew lines from the pizza to the person that he drew. Each line drawn represented the piece of pizza going to that person. From this drawing he was able to conclude that two pieces of pizza were eaten by each of the dancers (Appendix G). Hue is a young man that would normally read a problem once and if he did not see immediately how to do it he would stop. He is a bright boy and loves to draw so he enjoyed the lessons without numbers. I was pleased to see Hue use a picture to help him when he was not sure where to start at first. Academically he is ranked in the middle of this particular math class.

Shelly drew her pizzas, cut them into sixths and then counted each of the pieces to calculate how many pieces that each student would get (Appendix H). Shelly was one of my students who found it very difficult to solve word problems. She really thought about the problem before she started. She did a great job of explaining her picture and in using it to help her solve the problem. Shelly would be in the lower third academically in this class.

The last example was from Lee’s journal. Lee drew three pizzas and cut them into six pieces each. She numbered the pieces of pizza 1-18. Then she wrote the numbers 1,2,…,9 to represent the number of students. She put tally marks next to the number representing students until she had all of the pieces matched up with a number (Appendix I). Lee is one of the top
Making Sense 25

students in this class and works at her math problems until she has an answer. She had an
unusual way of using a picture to solve her problem. All of these student examples used pictures
to solve the word problem that had been given to them. These students had detailed explanations
with their drawings and as a group they represented the diversity of ability in that classroom.

I know that my students felt more confident and able to solve the problems on the post-
test from reading their journals and looking at the test scores. Jake’s journal on February 24 after
the pre-test said: “The test was the hardest ever. I was so frustrated. I could only get half of it
done because I had to guess on a lot of them and I don’t like to guess.” On the pre-test Jake
attempted 10 of the 33 problems and got six of them correct. Jake’s journal entry April 27 after
the post-test said:

“The post-test was really easy. I whipped right through it and got to the end without
realizing it. I now look at word problems as a regular problem that doesn’t slow me down
anymore. I don’t know what I’m doing differently, but whatever it is, I like it. The
hardest word problems for me, still, are ones that involve a circle.”

On Jake’s post-test he attempted all 33 questions and got 31 of them correct. Jake did not get
very far on his pre-test and after reading his journal entry I understood why. Jake is a talented
math student. He is usually the first to answer a question in class, and he is usually correct. For
him to encounter a test where he could not answer everything or even attempt to answer them
was incredibly frustrating to him. On the post-test, he did a great deal better. The best part was
when I read his post-test journal entry. I could almost feel the sense of pride and confidence as
he wrote about the experience.

Dani’s pre-test score was 14 correct out of the 29 problems that she attempted. On her
post-test she attempted all 33 questions and got 25 of them correct. On February 24 she wrote:
“The test was a bit hard. I enjoyed some of the questions that were easy for me to do. I did not finish though.” On April 27 she wrote: “I felt better about my test the 2nd time. But I was still kind of nervous. I definitely knew I did better though. Math test are my worst. Word problems are still NOT my favorite.” Even though math problems were still not a favorite of Dani, I could still see a change in her confidence as she mentioned in the first journal that she did the ones that were easy for her. On the post-test she did finish and in her post-test interview she mentioned that she knew that she had done better. This speaks volumes, when a student admits to doing the easy problems at first and then feeling like they did much better and attempting all of them.

Sky wrote on February 24: “I liked the concept of some of the problems, and some were easy. It was rather frustrating, though. Many of the problems were difficult.” Sky attempted all of the questions on the pre-test and got 17 of them correct. On the post-test she again attempted all of them but her number correct increased to 28. Her post-test journal entry read like this: “I felt pretty confident while taking the post-test. I had learned all of the information over the chapters. It was much easier this time. It was easy and I was happy while taking the test. That is how I felt after and during the test.” Sky came right out in her post journal and said that she felt more confident and again her increase in score showed the reason for this confidence.

Jo’s pre-test journal entry read like this: “I didn’t have time to finish the test. I didn’t like the Norway questions. I didn’t get it. I like the short questions. I understand most of the words.” Jo attempted 25 questions on this test and got 14 of them correct. On his post-test he attempted 31 of the questions and got 24 of them correct. His post-test entry he recalls his pre-test experience: “I felt good, because I did most of the problems and knew how to do them. Last time I didn’t finish 10 problems and guessed on some. I think I got a lot of them right. I felt good about this one.” The journal entry that Jo made in April was significant because he not only
mentioned not finishing the test, but also he brought up a problem that had him troubled. He later mentioned that he felt good about the second test. When a student feels good about a test this is sign of confidence. All of these journal entries were just chosen at random from all of the student journal entries. All of the students in the class made some comment about doing better or feeling better about the second test or their ability to solve the problems. I could have chosen four different students, and they still would have expressed similar opinions.

In the review project that we did in class, in which students taped the questions in the notebook, the only team that got question nine correct drew a picture. The question was about what the perimeter would be if four square tables were placed end to end (Appendix J). In analyzing the journals, test and homework, I can see that making charts, graphs and tables is a tool to use when other methods are not helping them to succeed. On March 13, the journal problem that day was about ratio and area. The students were to show the ratio of the area of one parallelogram to another. The first parallelogram had the same base as the second but the height was half as much as the second one. On the second part of the problem the first parallelogram height and base both were half of the height and base of the second parallelogram. The students were to write a ratio for the area on the two parallelograms for the second part of the problem also. They were given no measurements. This is what Wallace wrote in his journal and my responses: “I don’t get it?” My response: “What might help you to understand this problem more?” Wallace: “To know what the base, length and height was.” My Response: “Do you have to know those to solve the problem?” Then he tried again and this time he drew parallelograms and put his own numbers in (Appendix L). I made a journal entry about an interaction between a table group that I observed on review day. This is the review that I have made reference to earlier that took place on April 3.
The students at table one were sharing their answers with each other. They had all come up with the same answer so they were happy with that. Then Carl said the Shar: “You cannot solve the problem that way it does not look like mine.” Shar: “I got the right answer and I checked my work. I know that it is right. I’m not changing the way that I did it.” Mel said: “Remember we all have to be able to explain this solution if we are called upon.” Shar: “Fine but the teacher did not say that we all had to have the same process to get the answer. I used a different method. I don’t get it the way you guys did it.” Carl: “She might get some “Smarties” if she has an unusual way of solving it. Shar show me how you did that again.” Shar: “I am showing the teacher first.”

This is a wonderful example of students using various means to solve a problem. All of the students in this group came up with the same solution but the sixth graders took different paths to get reach their solution. Shar refused to change her answer just because it did not go along with Mel’s or Carl’s. Then when they realized that she was also correct, they wanted to see her method more closely.

The third research question that I investigated was: What will happen to the way that I teach word problems after I observe the way that my students explain the word problem-solving process in their journal? My teaching had already changed a great deal this year as my project progressed. I have a number of changes that I will make before I see my new set of students next year. On March 3 I made the following journal entry:

The kids I have noticed are trying to look at each other’s journals now. Apparently we are getting into tougher word problems and they are not sure what to do. I reminded them that I did not want to know how well they can copy their neighbors, I needed to know what they know.
Normally on journals I would not have cared so much but the journals had proven to be a very quick and reliable evaluation tool and I wanted my students to use them correctly. The math journals proved to be an excellent tool for catching skills that were troublesome to my students. When I read the journal entry and they did not know how to start a problem or had done it incorrectly, I could comment to the student right there next to the problem and the next day we could take care of the error. Many times they would comment back to me about understanding the problem now or by showing me what they had done after reading my comments to them (Appendix K).

On March 9 I wrote in my journal: “I have changed the way that I teach and I am changing the way that I grade. I am giving the kids credit for each step in their assignments. The kids are really having difficulty adjusting to this.” We used to correct homework every day and I would record the grades. During and since my project, I grade the journals and record these grades. The journal problems and explanations are a much better representation of what the student understands because the problem is completed during class time with no outside help. The students earn points for each step in the problem-solving process that they do correctly even though they may not get the correct answer. This is tough for some of my students because they do not want to show their work or write out why they did what they did. I have started using the phrase “show what you know” instead of “show your work.” My students enjoy sharing what they know.

On March 17 I wrote:

I discussed with my students today, about an error that I had noticed frequently in their journals. I had them journal to me first about the rules of dividing by decimals. Most kids
could tell me the rules but did not apply them in the mountain-climbing problem. This was a great opportunity for me to revisit this topic and stop an error before it got worse. When my students looked at their answer they did not understand that the answer they were giving did not make sense. On the 17th I went back into class and we discussed how to decide if the answer is reasonable or not. Then I addressed the issue of the wrong placement of the decimal in the answer. I had them write the rules of dividing a whole number by a decimal. Then I had them go back and look at their solution to the problem on March 9. Multiplying and dividing with decimals is a mastery skill for sixth grade on their Criterion Reference Test (our test that is reported to the state). I observed many students smacking themselves in the head as they discovered their errors. I really liked the fact that I was able to go back and revisit a skill that we had already covered and the students were able to fix the error right away.

Another way that my teaching changed was that every skill that I taught to my students once the project started was taught using a word problem rather than the conventional math equation. I tried to write math problems that had to do with things that interested my students. They were much more eager to solve the problems or at least attempt to solve them. The problems also made sense to my students because they were about things that my students cared about, such as buying Jonas Brothers tickets, skateboarding, going to the movies, texting and going to the high school sporting events. I read the journals very carefully and I tried to respond to any questions or to the steps that my students took. This was such a wonderful teaching tool to me and I will continue to use it the rest of the year with this class and in all of my classes in the years to come. In reading research about word problems and how they are taught, all of the articles that I read made some mention of the fact that the approach that teachers have taken in the past for teaching this skill needed to change.
Conclusions

I was very excited to begin my project, and I continued to be excited as the project was taking place. I learned so much about my teaching style and my students’ learning styles. This was project was time well spent.

Simplifying algebra equations is an introductory skill at the sixth grade level in our school district. Darby (2008) made reference to the fact that using fruit was a great way to make the connection in algebra of adding like terms. Darby interviewed six secondary math/science instructors in Australia. I took the idea that was given here, and I used play money to teach adding of like terms. The students seemed to grasp the idea of adding all of the dimes, nickels, and pennies and once I had them understanding that then it was easy to transfer to $x, x^2$ and so on. When my students got stuck it was easy to remind them of the like coins. Then the students were able to continue on. I would not have used this method of adding like terms had I not read about using the fruit in Darby’s research.

Teaching students that there is more than one way to solve a problem and to show how they solved a problem has become much more of a focus for me. I always had accepted alternative ways of solving math problems as long as they were mathematically sound. However, I did not really ever point this out to students. I have put a great deal more effort into pointing out alternate solutions that students have come up with and then I allow them to share them with the rest of the class. I discovered in doing this that my students’ solutions became much more thoughtful and creative. I stressed to my students that I wanted to see the method that they used to solve a problem so that if there was an error I could help them. Even more importantly, by looking at the way they wrote a solution, I could see how the student viewed the original problem. Throughout my research, I came across this idea many times. For instance,
Foley, Parmear and Cawley (2004) gave numerous ideas on how to allow students with learning disabilities to express their solutions to problems that did not require reading or writing. This research was extremely helpful to me as part of my quest to make word problems more enjoyable and useful to students that have low English-language ability or reading ability. As long as the students got the correct solution to the problem and the process was mathematically sound, we should be pleased as educators. The authors also agreed that there could be more than solution to real-world problems and that we as educators need to be more open to this concept.

**Implications**

I was so pleased with the outcome of my project and the tremendous growth that I witnessed in my students that I will be using journals in all of my classes next year. I have decided that on the first day of a lesson, I will spend a great deal of time teaching the concept and watching my students practice it. Then, I will give them one problem to solve in their journal and explain each step. This will allow me the opportunity to check for any misconceptions they may have. I think that this will be easier to correct than if I allow them to go home and do 20 problems the wrong way and then try to undo it the next day. It was wonderful to have the students explain their work to me and their steps. It is so empowering to me as a teacher. It will take more time because of all of the reading but in the long run the amount of time taken to re-teach a skill should be reduced. I also will be developing a series of word problems to cover all of the sixth and seventh grade standards that deal with topics that the students are interested in. I hope that this will help to change their opinions of word problems and help them to see a true practical use for the math that they are learning in class.

I already have shared a great deal about my project and the discoveries that I have made with my administration and fellow sixth grade teachers. Our math department chair teaches at the
eighth grade level and she has also followed my project closely. She is the one who convinced me to apply to Math in the Middle. She has used some of my new methods in her classroom this year. She will have me share at our department meetings next fall at the start of the school year. The three seventh grade math teachers hopefully will try some of these ideas. I have also shared my project with some fifth grade teachers. They want to know more about my project and the changes that I have made. Later this summer, I will share with them some techniques that I think would be helpful to them.
References


Appendix A

Five Minute Survey

Rank from one to five each of the following statements.
One means that you agree the least and five means that you agree the most.

1) It is important to understand the vocabulary words in math before performing the skill.

   1  2  3  4  5

2) I enjoy solving word problems.

   1  2  3  4  5

3) Word problems are difficult to solve.

   1  2  3  4  5

4) I think that it is important to have homework to practice the math skills.

   1  2  3  4  5

5) I enjoy math class

   1  2  3  4  5

6) When I have a difficult math problem, I stick to it until it is solved.

   1  2  3  4  5
Appendix B

Student Pre Interview Questions

1) How much time on average do you spend on math homework assignments?

2) What do you like best about math? What do you like least about math?

3) What would you tell someone who is new to our class, what it takes to be successful in this math class?

4) When working a word problem, do you think you know the meaning of most of the vocabulary words in each problem? Please give some examples?

5) I would like you to work on this problem, saying aloud whatever it is you are thinking as you work through the problem. I especially want to hear you talk about how you decide what to do to solve the problem.

   **Brooke is saving money to buy a bike that costs $72. She wants to buy the bike after saving the same amount of money each week for 6 weeks. How much money does she need to save each week?**

6) Why is it important to know the meanings of vocabulary words that you see in math?

7) Is there anything else I should know about you to better understand your problem solving in math or your general math experience?

8) What do you think is the purpose of word problems?
Appendix C

Name: ____________________________ Class: ____________________________ Date: ____________ ID: A

're Word Problem Test

Numeric Response

1. At Daisy’s Deli, Daisy tracks her monthly profit to determine the success of her business. A negative profit means that Daisy has debt. In July, her profit was -$20. In August, her profit was $160. Find the difference between the profits in July and August.

2. Two classes compete in a science fair. Each class splits into smaller groups, but every group, both classes included, must be the same size. The first class has 176 students, and the second class has 128 students. What is the greatest number of students each group can have?

3. A restaurant uses \(4\frac{2}{3}\) cups of rice to make its daily pot of rice. Write a fraction that shows how many \(\frac{3}{4}\)-cups are used to cook rice each day at the restaurant.

Short Answer

4. Suppose you have developed a scale that indicates the brightness of sunlight. Each category in the table is 9 times brighter than the next lower category. For example, a day that is dazzling is 9 times brighter than a day that is radiant. How many times brighter is a dazzling day than an illuminated day?

<table>
<thead>
<tr>
<th>Sunlight Intensity</th>
<th>Brightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dim</td>
<td>2</td>
</tr>
<tr>
<td>Illuminated</td>
<td>3</td>
</tr>
<tr>
<td>Radiant</td>
<td>4</td>
</tr>
<tr>
<td>Dazzling</td>
<td>5</td>
</tr>
</tbody>
</table>

5. Pablo earns money by caring for turtles while people are on vacation. Pablo earns $25 per week per pet. The table shows the number of turtles cared for per week during July. Evaluate the expression \((4 + 2 \times 3) \times 25\) to find out how much Pablo earned for the month of July.

<table>
<thead>
<tr>
<th>Week</th>
<th>Pets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>4</td>
</tr>
<tr>
<td>Week 2</td>
<td>2</td>
</tr>
<tr>
<td>Week 3</td>
<td>2</td>
</tr>
<tr>
<td>Week 4</td>
<td>2</td>
</tr>
</tbody>
</table>

6. In an online media store, downloaded songs cost $3 each and books cost $9 each. Taji paid $7 in sales tax when he purchased 15 songs and 3 books. Write and evaluate an expression to show how much Taji spent on everything, including sales tax.

7. A fence has a total of 650 planks. Violeta paints \(n\) planks each day. Write an algebraic expression for how many days it will take Violeta to finish painting the fence.

8. It takes 78 days to create a custom motorcycle. Write an algebraic expression to describe the number of days it takes to create \(n\) custom motorcycles. How many days will it take to create 6 custom motorcycles?
9. Jaime makes $9$ dollars per hour installing computers. The table shows the number of hours he worked each week in July. Write and simplify an expression for the amount of money Jaime earned in July. Evaluate the expression for \( t = 11.50 \).

<table>
<thead>
<tr>
<th>Hours Jaime Worked</th>
<th>Week</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>19.0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>19.5</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>17.5</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>23.0</td>
</tr>
</tbody>
</table>

10. Thomas wants to display leaf specimens for a science fair. Thomas has 25 leaves, which is 19 fewer than the total needed. Will the science display have a total of 45 leaves, 44 leaves, 6 leaves, or 54 leaves?

11. Hector and Selma play baseball. Selma has 13 trophies. Hector has 5 fewer trophies than Selma has. Write an equation showing this, using \( h \) as the number of trophies Hector has.

12. The income from the Spanish Club's bake sale was $240. Expenses for the sale totaled $40. Use integer addition to find the total profit or loss from the bake sale.

13. The highest temperature recorded in the town of Westgate this summer was 100°F. Last winter, the lowest temperature recorded was -1°F. Find the difference between these extremes.

14. A submarine started at the surface of the water and was moving down at -15 kilometers per minute toward the ocean floor. The submarine traveled at this rate for 48 minutes before coming to rest on the ocean floor. What is the depth of the ocean floor?

15. The range of a set of scores is 23, and the lowest score is 37. Write and solve an equation to find the highest score. (Hint: In a data set, the range is the difference between the highest and the lowest values.)

16. Lauren visits the park every 3 days and goes to the library every 10 days. If Lauren does both of these today, how many days will pass before Lauren gets to do them both on the same day again?

17. Yolanda writes an email to her best friend in Oregon every day, an email to her brother every 3 days, and a letter to her cousin every 5 days. On March 10, she writes to all three of them. On what date will she next write to all three of them?

18. Victoria and Anne are sisters who both take piano lessons. Each day, Victoria practices piano for \( \frac{3}{4} \) hours, and Anne practices piano for \( 1\frac{3}{4} \) hours. Do the sisters practice piano for the same amount of time?

19. In Norway, the krone (plural: kroner) is the basic unit of currency. Edwina traveled to Norway in 2004. When she returned to the United States, Edwina converted 142.91 kroner to dollars at an exchange rate of 6.97 kroner per dollar. About how many dollars did she receive?

20. Two pounds of corned beef cost $14.91, and a package of cabbage cost $3.34. What is the total cost of the corned beef and the cabbage?

21. Mrs. Feng's science class needs to collect $52.00 to purchase a hamster, food, and bedding. In addition, the class will need $57.46 for the hamster's cage and supplies. If there are 26 students in the class, what is the average amount each student needs to collect?

22. Mr. and Mrs. Nozaki are moving from Riverside to Princeton. The distance from their old house to their new house is 1128.85 miles. If their car gets 21.1 miles per gallon, how many gallons of gas will they need for the trip?
23. In the last three years, Frederico’s basketball team won 30 more games than they lost. If they won 130 games, what was the ratio of wins to losses? Write the ratio in all three forms.

24. Larry took 22 minutes to do 13 math problems. Mary took 24 minutes to do 12 math problems. Which student did more problems per minute?

25. Tony and Tiffany collect semi-precious stones. At the Rockhound Hut, Tiffany paid $38 for 9 pounds of snowflake obsidian. At The Solid Rock Shop, Tony paid $19 for 3 pounds of the same type of stone. Who made the better buy?

26. A compound is made up of various elements totaling 90 ounces. If the total amount of uranium in the compound weighs 18 ounces, what percent of the compound is made up of uranium? Decide whether using pencil and paper, mental math, or a calculator is most useful when solving the problem. Then, solve. If necessary, round your answer to the nearest hundredth.

27. ABC Shoes and Lo-Price Shoes both sell QuickRunner shoes. ABC Shoes sells the shoes for $60.05, and Lo-Price Shoes sells them for $38.85. Today, ABC Shoes decides to offer a 30% discount. Which store offers the better deal?

28. Eddicycle Cycle Shop sells the Ultra Extreme X mountain bike for $179.98. Kammie Cycles sells the same bicycle for $280.20. Today, Kammie Cycles decides to offer a 19% discount on the mountain bike. Which store offers the better deal?

29. Iris wants to buy two necklaces, one for her sister and one for herself. The necklace for her sister costs $42.00, and the necklace for herself costs $28.00. The sales tax on the purchases is 8%. Find the total cost of Iris’s purchases, including sales tax. If necessary, round your answer to the nearest cent.

30. The price of a train ticket from Orlando to Atlanta is normally $118.00. However, the train company is offering a special 75% discount to children under the age of 16. What is the sale price of a ticket from Orlando to Atlanta for someone under the age of 16?

31. A teacher surveys all of the students in the school to find out each student’s favorite class. The bar graph shows the results of his survey. How many more students prefer Math than prefer Science? Use the bar graph to answer the question.

32. Anna is planning on making a circular garden. If the diameter of the garden is 21 meters, what is the circumference? Use 3.14 for $\pi$.
33. For her birthday party, Kelly invited her friends to a nearby roller-skating rink. The area of the rectangular rink is 2,277 ft^2, and the length is 69 ft. What is the width of the rink?
Appendix D

Math - Problem Solving : Journal

Teacher Name: Mrs. Ronhovde

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Date Created: Nov 21, 2008 07:41 pm (CST)
### Appendix E

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PSQ = Pre survey question  
Q = Post survey question
Appendix G

2-17-09
I don’t really like word problems, they’ve always been pretty hard for me to figure out. So if I walked into class and we had to work on word problems the whole class I wouldn’t be happy about it.

2-20-09
I would like art, biking, books, pizza, for my topics.

2-24-09
I didn’t really like the test because it was really hard and I didn’t know some of the stuff and I only got halfway through it. I like it though because it was challenging.

2-25-09

First divide the pizzas into sixths, then give each child a piece of pizza, then you’ll have a piece left, so each child gets 2 pieces.
Appendix H

2/17/09
If I walked into the room and you said we were going to work on story problems the whole class I would freak out because I hate story problems. I would also kinda like the extra practice.

2/20/09
1. dogs
2. hockey
3. basketball
4. horses

Feb 15, 2009
There are nine students. If each pizza is sliced into six, how many slices would each student receive if the slices were shared evenly? I first counted how many pieces there were total then I divided it by 9 and got 2.
Appendix I

2-20-09

These are some topics I’d like to see are:

- corn
- cars
- planes
- milk
- lawn mowers
- pots
- snow
- sun
- moon

2-25-09

Pizza: cheese, pepperoni, pepperoni

There are nine students. If each pizza is sliced into eighths, how many slices would each student receive if slices are shared evenly?

18 slices of pizza

2 slices each

Students

1 1/11 2 1/11 3 1/11 4 1/11 5 1/11 6 1/11 7 1/11 8 1/11
Appendix J

9. Four square tables with sides of 48 inches each are placed end to end to form one big table. What is the perimeter of the table that is formed?
   A 192 in.  C 480 in.
   B 384 in.  D 768 in.  

7. A welcome mat on the front porch is a semicircle. The straight side of the mat is 36 inches. What is the perimeter of the mat?
   A 92.52 in.  C 66.52 in.  
   B 64.26 in.  D 28.26 in.
At the county fair, the apple pies are lined up side-by-side for judging on a 6-foot table. Each pie has an area of 50.24 square inches. How many pies are on the table?

First,
\[ A = \pi r^2 \]
\[ A = 2.11 
\]
\[ A = 3.14 \times 1.6 \]
\[ A = 50.24 \]

Next, see how many times 8 in go into 6 ft.

Last, divide \( \frac{72}{9} \) you know. Let me you go with \( \frac{72}{9} \).

9 pies
Appendix L

3-13-09 #25 pg. 533

Two parallelograms have the same base length, but the height of the first is half that of the second. What is the ratio of the area of the first parallelogram to that of the second? What would the ratio be if both the height and the base of the first parallelogram were half those of the second?

I don't get it? Do you have a simple example you can relate to this problem mae?

3-17-09

Explain the rules of dividing decimals to me. Here is a simple problem. Tell me how you would solve it please. 100.25

(1) you write the problem

50 | 100.25

(2) then you divide

My second try.

\[ A = \text{length} \times \text{width} \]

\[ 2 \times 3 = 6 \text{ units} \]

\[ 4 \times 3 = 12^2 \text{ units}^2 \]

\[ 3 \times 3 = 9 \text{ units}^2 \]

\[ \frac{100.25}{12^2} = \frac{100.25}{144} \]
3-17-09

Jose's goal is to save up enough money to put a $2,000 deposit on a $8,000 vehicle. Jose makes $1,300 per month. Assuming Jose pays his bills and saves everything that is left over, how long will it take Jose to save up enough money for a $2,000 deposit?

In your own words, why do you need to exercise to save money each month, if you need money for gas, food, rent, and other expenses?

1.0 months = how many months with Jose

3-18-09

Please draw the following shapes in your journal: circle, square, rectangle, and triangle. Make them large enough to write inside of.

[Drawings of a circle, square, rectangle, and triangle]