Student Problem Solving

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Abstract

The purpose of this study is to determine if students solve math problems using addition, subtraction, multiplication, and division consistently and whether students transfer these skills to other mathematical situations and solutions. In this action research study, a classroom of 6th grade mathematics students was used to investigate how students solve word problems and how they determine which mathematical approach to use to solve a problem. It was discovered that many of the students read and re-read a question before they try to find an answer. Most students will check their answer to determine if it is correct and makes sense. Most students agree that mastering basic math facts is very important for problem solving and prefer mathematics that does not focus on problem solving. As a result of this research, it will be emphasized to the building principal and staff the need for a unified and focused curriculum with a scope and sequence for delivery that is consistently followed. The importance of managing basic math skills and making sure each student is challenged to be a mathematical thinker will be stressed.

The focus of this action research is problem solving in mathematics and which problem solving methods students choose to solve a problem. I am trying to determine what learning experiences help math processes become more apparent to students when solving problems. Students need to be able to solve problems in mathematics and then generalize that skill to other situations that occur in the world around them. The purpose of this action research is to find methods of teaching problem solving skills and computational skills that will help students determine which mathematical processes to use when solving problems.

This is an action research study of my own classroom, where I have taught math for five years. I have been teaching for 17 years, eight of those have been in the middle school setting as a math, social studies and reading teacher. My prior teaching experience was with 4th and 5th grade students over a period of nine years in self-contained, inclusive classrooms teaching all subject areas. I have placed my focus this school year on the math classes in the 6^{th} grade and how students problem solve. As a researcher in the classroom, I have had to be very keen in my observations of students when they process questions. I have made note of how students answer questions both in writing and orally. The order in which math concepts are taught was adapted for this research project (see Attachment A). I would like to have consistency in my building with sequencing when math concepts are taught during the year. I believe that building student knowledge and strengthening computational skills will help students be better problem solvers.

PROBLEM OF PRACTICE

Students do not solve math problems using addition, subtraction, multiplication, and division consistently. Students do not easily transfer these skills to other mathematical situations and solutions. How can my teaching practices improve students' basic math skills

involving computation? How can my teaching improve student transfer of problem solving skills and the retention of basic math facts and functions?

The current state of my classroom indicates that the majority of students lack basic math knowledge in order to have success and learn new concepts as they are taught. This was evident when addition, subtraction, multiplication and division were assessed when school began in August. When student comprehension of place value, rounding and ordering from least to greatest was assessed students were not able to apply from practice what they learned. Concepts were re-taught and reassessed with better results.

The ideal classroom would embrace each new concept taught with vigor. Lessons would engage student learning in such a way that they would be able to solve problems using an approach that they were able to understand and apply. New concepts such as factoring out a number using prime factorization and exponents would challenge and engage learning.

Why is this problem worth knowing about? Students need to engage in their learning. If I am more aware of my lesson design and thoughtful in planning, implementing and assessing a lesson, the students should have greater comprehension of concepts taught and practiced, and therefore be able to apply math facts and functions to problem solving. Do students apply what they have learned on a daily basis? Could there be a way of planning and implementing strategies to help students become better at computational skills and then apply those skills to other math situations? Student success is essential and students need to have a strong math foundation before entering high school. If an approach to this problem can be determined, results can be shared with colleagues so that all students can benefit.

Perhaps the curriculum we teach is not sequenced in a way that supports student use of their acquired skills. Maybe too much emphasis is placed on taking assessments based on standards instead of teaching students how to gain and retain the skills being assessed based

on those same standards. When teachers can find practices that help the student succeed and the students are able to apply what they have learned to daily tasks and larger problems such as problem solving or other mathematical concepts like finding the area of a right triangle, then we will begin to see the value of basic mathematical skills. Teachers will become empowered as the first and foremost important instrument in helping children learn what they need to learn to be successful. When the students have the skills necessary to apply them to multiple situations the community will benefit as well.

Imagine all the high school students who work in local communities and how many of these students lack the basic skills necessary to accomplish a task. When a 16 year old cannot count back change, add up a bill, or separate a box of ordered goods evenly then we find they lack the foundation they need. Most higher-level math courses do not focus on basic skills because they have a curriculum that requires more improved skills. These courses also teach students to prepare for further education. Therefore, the basic math skills need to be taught, reinforced, and applied at the middle school level.

Communities expect schools to give each and every child an opportunity to learn and to place into practice what they have learned. Some people may believe that schools just help a child along and that they find their ability on their own and learn how to do a job later in life. Part of what schools are trying to accomplish should include making sure that we have given the child every opportunity to learn and apply what they have learned in school and to use their skills daily so that when the time comes for them to wait tables, use a cash register, figure out the dimensions of a little league baseball field in order to set bases and chalk the field, they have the skills to accomplish their task.

Teachers who work with students on a daily basis will also begin to see their value on a larger scale. The work teachers do and the progress that is made will be directly related to

their input. Working to solve this problem of practice will allow teachers to examine how they teach and what they teach. Working to solve this problem of practice will allow students to learn to apply skills at a basic level and transfer these skills to a higher level at a later time. Working to solve this problem of practice relates directly to what is done in education on a continual basis: adjust, adapt, and make changes based upon student need. Perhaps the curriculum, the way the curriculum is taught, or the sequence in which it is taught could be improved upon. The purpose of this action research study is to find out if a different approach to teaching math will affect student learning and mastery of basic facts and computational skills.

LITERATURE REVIEW

A literature review revealed that problem solving is a very important skill in the middle and upper grades and that research should support how problem solving is approached by students. Consider the Problem of Practice statement, "Students do not solve math problems using addition, subtraction, multiplication, and division consistently. Students do not transfer these skills to other mathematical situations and solutions." How can teaching practices improve students' basic math skills involving computation, student transfer of problem solving skills, and the retention of basic math facts and functions? Over a period of months my students have ample opportunity to advance both developmentally and emotionally. Most of these students have proven that through experiences and time they have become better problem solvers.

Most of the articles reviewed did not have data that was gathered and analyzed within the last four to five years. It was found that many studies and articles had data that was gathered from studies and interviews done in the late 1980s and 1990s. ERIC and the What Works Clearinghouse, Institute for Education Sciences, were used to find articles for this

literature review. Two of these articles, *Self-Efficacy, Motivation Constructs, and Mathematics Performance of Entering Middle School Students* by Pajares and Graham (1999) from Emory University, and *The Effects of Mathematics Drill and Practice and Gaming Web Sites upon the Mathematics Achievement of Fourth Graders,* research by Kendrick (2004), appeared to be action research. The data was gathered by the authors of the articles and the articles stated that the authors did the actual research in a classroom. A third article was a TIMSS study *Primary and Middle School Data; Some Technical Concerns* by Wang (2001). This article focuses on an in-depth examination of student performance from the TIMSS studies. Although the focus of this literature review was on these three articles, a number of other articles were reviewed that were related to the problem of practice under study in this research. Many articles were found that focused on early elementary school and higher education. Not nearly as many were found at the middle level, available for print, or related to my specific area of study. Further searching revealed two more articles *Research on Teaching Mathematics by* Ball (1988) and *Math Facts* written by the authors of *Math Trailblazers,* TIG, Grade 5, TIMS Tutor (2002). These two articles are research studies.

The article that first gained my attention was a TIMSS study conducted to compare how average performance in math by middle school students from the United States faired against middle school students from other countries. The results showed that in 1995, U.S. eighth graders performed slightly below the average in mathematics in comparison to other 8^{th} grade students in other developed countries (Beaton et al., 1996a, 1996b). Using results from primary and middle schools, Schmidt and Mcknight (1998) reported "a decline in the relative standing of U.S. students from fourth to eighth grade in mathematics as compared to those in other countries"(p1830).

The middle school findings were confirmed by a repeat of the TIMSS project (TIMSS – R) four years later in 1999 (Martin et al., 2000; Mullis, et al., 2000). The purpose of this article was to extend the discussion of TIMSS findings to the primary and middle school levels. This particular statement sparked my attention since I am interested in finding out how students might retain and apply mathematical skills more consistently. There were several problematic outliers pointed out within this article such as populations that were being compared, test booklets having discrepant structures, and TIMSS tests that might not align with what students have learned due to content differences among countries. This research is quantitative in nature and is research done by outsiders. The results of the TIMSS study are beneficial if we are interested in how students perform compared to their counterparts in other countries around the globe.

The online article, *The Effects of Mathematics Drill and Practice and Gaming Web Sites upon the Mathematics Achievement of Fourth Graders*, research by Kendrick (2004), is an example of action research. It focuses on part of my question concerning drill and practice for retention of mathematical skills. No research was found analyzing the effectiveness of any internet based mathematics program. Kendrick had difficulties finding research after 1985. The research is inside research and is intended to give Kendrick and other educators information in regard to drill and practice. The kind of data collected and the means of analysis indicate quantitative research.

There was much to say about the number of students and teachers who use technology and Web sites for drill of basic skills and practice, but there were no empirical findings that would support or rebut what is trying to be determined in the question of retention and application of skills. Research did indicate that drill and practice and gaming software is most effective when students are practicing a task with which they are already

familiar. This would indicate a method to use to help reinforce learned applications. The immediate feedback that gaming software provides was very beneficial to student retention of drill and skill. Research did indicate that there was not any growth in ability by using computer based drill and skill over traditional practices like paper pencil activities and the use of flash cards or daily learning centers and activities. Results revealed that fourth graders grew by 0.15 of a grade level while eighth graders decreased by .06 of a grade level when assessed against students who did not primarily use gaming software. These results would indicate there really is not much growth by students when using gaming software.

Kendrick's article referred to research conducted by Ashcroft (1981) that stated that the use of counting patterns and mental retrieval showed a connection between mental retrieval and solving of more complex number problems. Drill and skill enhance memory and one's ability to retrieve stored information within your own memory from adolescence to adulthood. Kendrick's research began with a problem statement and was a quantitative inquiry. Kendrick wanted to know the effectiveness of drill and skill using technology or gaming programs. Students in a control group took an assessment and were compared to those who did not use gaming programs over a period of several months. The results were about the same and indicative of what the Ashcroft study found that drill and practice, and using counting patterns improve student retrieval for solving problems.

Review of research indicates that there are many strategies that need to be implemented in order to help students achieve retention of skills and be able to recall mathematical facts and in turn, apply those skills to other problem solving situations. Kendrick's article provided useful information with regard to my problem of practice.

Self-Efficacy, Motivation Constructs, and Mathematics Performance of Entering Middle School Students by Pajares and Graham (1999) had an objective of determining the

influence of motivation variables on task-specific mathematics performance and whether the variables change during the first year of middle school. This research was done by outsiders and was qualitative in nature. The study indicated that self-efficacy has an effect on math performance. How students perceive themselves and whether or not they are confident about mathematics has a direct impact on performance. The study allowed for gender separation, which indicated that boys are more efficacious than girls. Girls tend to be more under-confident and boys tend to be more over-confident when it comes to predicting how they will do in math. One area that students were asked to rate is how they would do in high stakes testing. When comparing how the students thought they would perform and how they actually performed results indicated that self-efficacy beliefs predict academic outcomes. This research indicates that practitioners should be examining students' beliefs about their mathematics capabilities because they are important influences on motivation and academic achievement.

Ball's article, *Research on Teaching Mathematics: Making Subject Matter Knowledge Part of The Equation* (1999), examines whether teacher knowledge of content has much of an impact on student learning. Although teacher background is vital and they must have an understanding of what they are teaching, the more one knows does not necessarily mean the more effective they will be. Being a veteran teacher of 17 years, I have to appreciate what the study indicated as effective teaching practices such as pacing, questioning, explanation, praise, clarity, directness, and enthusiasm. The study also indicates that a strong background is vital when combined with effective teaching practices. The article discussed the appreciation that the researchers began to show for the complexity of classrooms and of the job of teaching.

Teachers work with a broad range of students with different attitudes and abilities and are responsible for a variety of educational outcomes that require different approaches. Another component mentioned is that teachers have to change and adapt to progress and to what research shows are effective practices. Curriculum decisions and knowledge are significant variables to student learning. A mix of approaches to teaching and learning is what is necessary for optimum student achievement. The research revisits teacher background and teacher content knowledge and the impact they have on student learning. A teacher must have a strong background in the subject they teach, especially mathematics and other specialized areas. Middle school teachers' knowledge is vital in this variable. This research article ties into my overall question, "How can my teaching practices improve students' basic math skills involving computation, student transfer of problem solving skills, and the retention of basic math facts and functions?"

Math Facts by the authors of *Math Trailblazers* is an article from TIG and TIMS Tutor 2002 (p. 253-265) with a focus on math facts. The authors state that basic facts need to be learned and are an important component to problem solving. Students develop natural strategies for learning facts that lend to problem solving which is much more than just memorizing facts and rules that "you either get or you don't." This article indicates that a de-emphasis on rote work and an increase of useful strategies to find facts will help students become better problem solvers. Research results (Isaacs & Carroll, 1999; Van de Walle, 2001; National Research Council, 2001) show that gradual and systematic introduction of facts with ongoing practice over years help students achieve fluency in math facts useful in problem solving.

A very detailed set of strategies is laid out for addition, subtraction, multiplication, and division facts. The math facts are scoped and sequenced from kindergarten to fifth grade

and support what will be challenged and achieved in the middle level grades. Different strategies appeal to different students, and a wide variety of strategies are offered in the article. Giving the student the ability to process what they are trying to find out or what they know in a problem allows them to be more confident problem solvers. The *Math Trailblazers* math facts program pervades most of the curriculum's components. "Our ultimate goal is to produce students who can think mathematically, solve problems, deal easily with quantified information, and enjoy mathematics and are not afraid of it. It is easier to do all of the above if one has fluency with the basic math facts." (*Math Trailblazers* 2002) Research provides clear indications for those who develop curriculum and teachers who implement that curriculum. Recommendations for the *Math Trailblazers* math facts program came from using current research.

This research study is going to focus on teaching practices that will help students retain what they learn and recall those skills when needed. This study is very important to my local community and me because it will indicate which practices best help students in mathematics. There are several factors that will need to be taken into account and the research I have read has given more light on the topic of learning and using mathematics to solve problems. I do not see that the study will greatly impact any published research. I have had this study in mind for about a year now and believe implemented changes since the school year began have been effective. My further education, and having to conduct reading research, and creating a long-term plan of study will impact my teaching and my students' learning of mathematics.

PURPOSE STATEMENT/RESEARCH QUESTIONS

The purpose of this study was to determine if students solve math problems using addition, subtraction, multiplication, and division consistently and whether students transfer these

skills to other mathematical situations and solutions. Data collection took place during the spring semester 2006 in the researcher's classroom. This study attempts to answer these research questions:

- What learning experiences help math processes become more concrete?
- What activities best help students learn math processes and where they apply them?
- How do related math concepts like place value and math properties support student learning of computation?
- How do students determine which mathematical processes to use to solve a problem, and how do students determine if they have chosen the correct computational method?

METHOD

The beginning point for my research was in the fall when I decided to adjust the sequence of how math concepts would be presented this school year (see Attachment A). I used my literature review to help me determine in what order concepts should be taught during the school year and when they should be taught based on our district curriculum guide. Twenty-three students ages 11 and 12 are the subjects of this study. There are 14 boys and 9 girls in this group.

During the spring semester of 2006, I administered a survey to the students who were a part of this research (See Attachment B). This survey, along with student journals and my personal daily journal, gave good indications as to what learning experiences help math processes become more concrete for students. I gave the students the survey the first week of April. The survey was given only once because of time constraints due to IRB approval of my research. Responses from the survey were categorized and quantified. I also kept a daily journal that documented lessons taught, what took place, observations that I made related to

the problem, and successes and failures of my lessons. The journal was kept from February 7, 2006, until May 3, 2006. The entries are detailed and provide daily observations of my thoughts and observations. Student journals were also kept during the spring semester and have allowed me to analyze how students process mathematical problems. The students turned in five journals over as many weeks. The focus of the student's journal question was tied into daily or weekly lessons. They were asked to describe what they had learned during the lesson and how what they had learned applied to math.

In order to determine what activities best help students learn math processes and where they apply, I utilized three methods. First, I interviewed (see attachment C) my building principal, to gather some insight from an administrative perspective as to what activities help students learn math processes and how to apply what they have learned. Analyzing the entries in my daily journal, a second source of data, provided additional information for this question. The third source of data for this question was a test developed by my local Educational Service Unit for use to report for AYP on how students perform in the area of problem solving. This test is based on the state standard for problem solving and has a Form A and Form B allowing me to use it as a pre- and post-test (see attachments D and E). I gave the pre-test in January of 2006 and the post-test in late April of 2006.

My daily journal is very important in my research because of the daily observations and reflections. I am able to discuss how related math concepts like place value and math properties support student learning of computation. I am using student performance on a daily basis and assessments that students take as a basis for addressing how related math concepts support student learning in this research along with my daily journal. The findings in the journal and student performance were from January 2006 to May 2006.

Student interviews were conducted to help determine which mathematical processes students use to solve a problem and how they determine if they have chosen the correct computational method (see attachment F). These interviews took place during April 2006. I was able to interview seven out of 23 students and found the interviews to be very informative.

Through the use of assessments, interviews, personal and student journals, and monitoring of daily student progress, I was able to gather data related to the questions addressed in my purpose statement.

ANALYSIS

Initially, I did not see a clear answer as to which learning experiences help students understand how to best process math concepts. The best assertion I can make is that one-on-one teacher to student instruction with examples given by students seems to work well. I do see some benefit in students working in pairs, explaining to one another how they would solve a problem. However, at this age, students are more focused on their own thinking processes and not others. The more opportunities for practice on new skills does help with performance on quizzes.

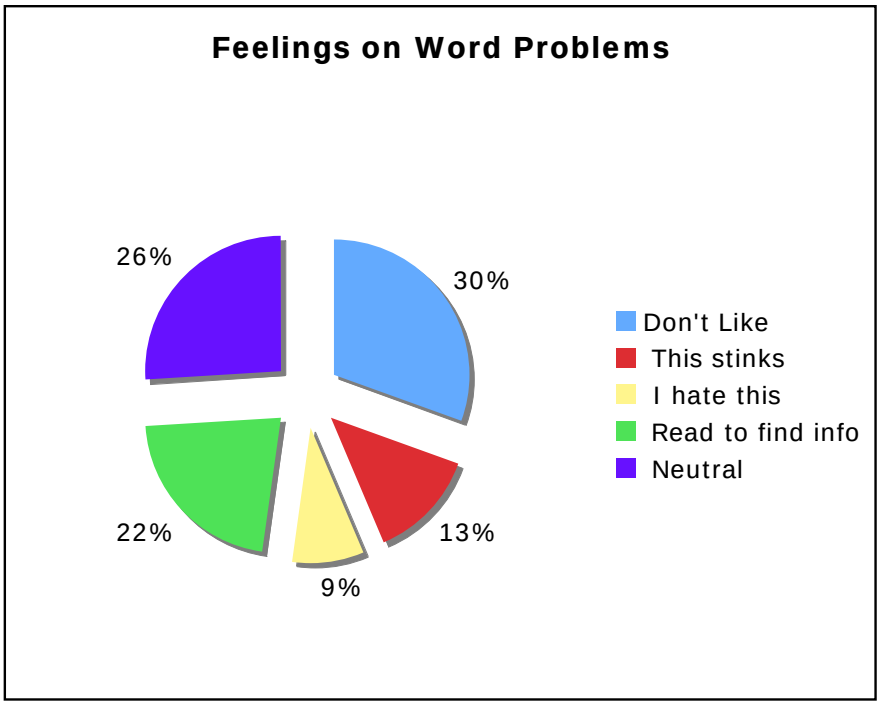
I only allowed a few days of practice after initially teaching ratios and proportions and most students tested within the proficient or advanced range. When they began to work with exponential values and expanded notation along with order of operations, there was not as much practice time available and they did not perform as well on the quizzes. I believe that increased opportunities for practice on new skills is the most effective method for student learning. I am finding that when students discuss in class and write exit-journals they are beginning to remember processes and are trying to apply those processes to other situations. Students do not generally know if they have chosen the right way of solving a

problem until we discuss possible answers as a class. I am finding few will risk failure for success.

My first assertion is that homework does make a difference in student learning and retention of math processes. I believe this to be true from the results of the survey, and analysis of my journal, and the student's journals.

Twenty-three students took the survey for problem solving (see attachment B). The first question "What words would you use to describe your feelings when you get a math assignment that is mostly word problems?" solicited five typical responses:

- Don't Like – 7
- This stinks – 3
- I hate this – 2
- Read to find information – 5
- Neutral – 6



This question indicates that 52% of the students do not like word problems. The other 48% are neutral or read further to find more information about the question being asked.

The second question was a scaled seven-part question asking students to rate their agreement with each statement on a scale of Strongly Agree (1) to Strongly Disagree (5). The results of question 2 are listed below with a mean, mode and standard deviation for each part of the question.

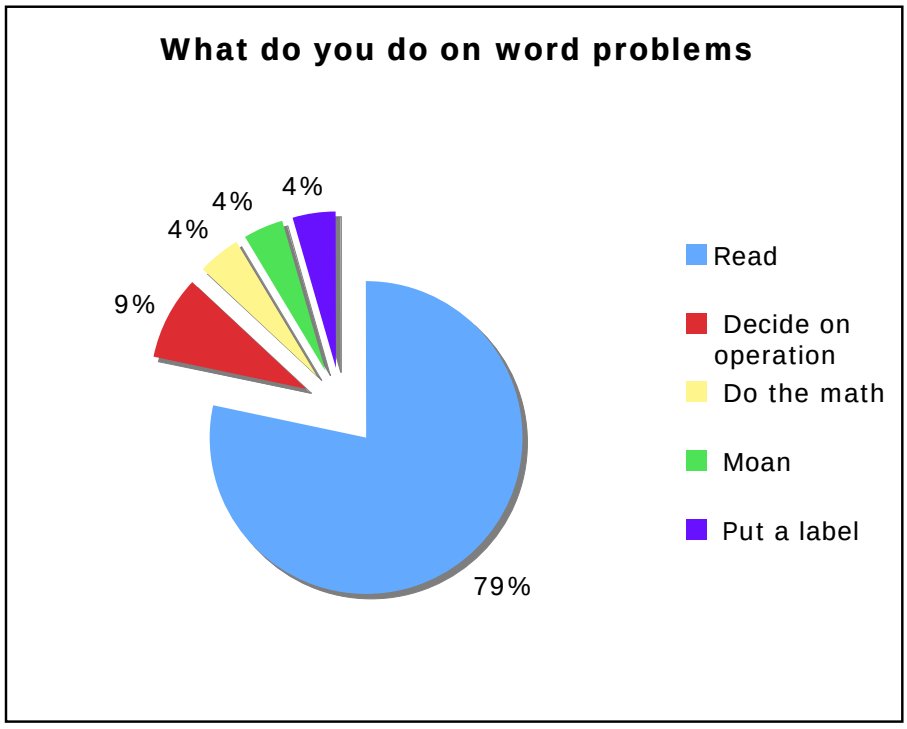
- 2a, My teacher takes time to make sure I understand the Math Lesson.
- 2b, I feel successful in Math class when I complete homework, quizzes, and tests.
- 2c, I have Math homework at least 3 days a week 30 minutes or less.
- 2d, I learn Math concepts pretty easily.
- 2e, Math problems have one correct answer.
- 2f, There is only one way to get the right answer to a Math problem.
- 2g, Knowing basic facts helps students solve word problems better.

	Mean	Mode	Standard Deviation
2a	1.435	1 – Strongly Agree (14)	.5896
2b	1.652	2 – Agree (11)	.6472
2c	1.8696	2 – Agree (11)	.6944
2d	1.956	2 – Agree (15)	.6381
2e	2.869	2 – Agree (9)	1.254
2f	4.304	5 – Strongly Disagree (12)	.8754
2g	1.565	1 – Strongly Agree (12)	.7276

The student responses indicated that they feel successful in math and that practice is a factor in learning how to solve word problems. The survey also showed that students agree homework and teacher interaction benefit student learning of problem solving.

The third question, "What is the first thing you usually do when you see a math word problem?" solicited five typical responses:

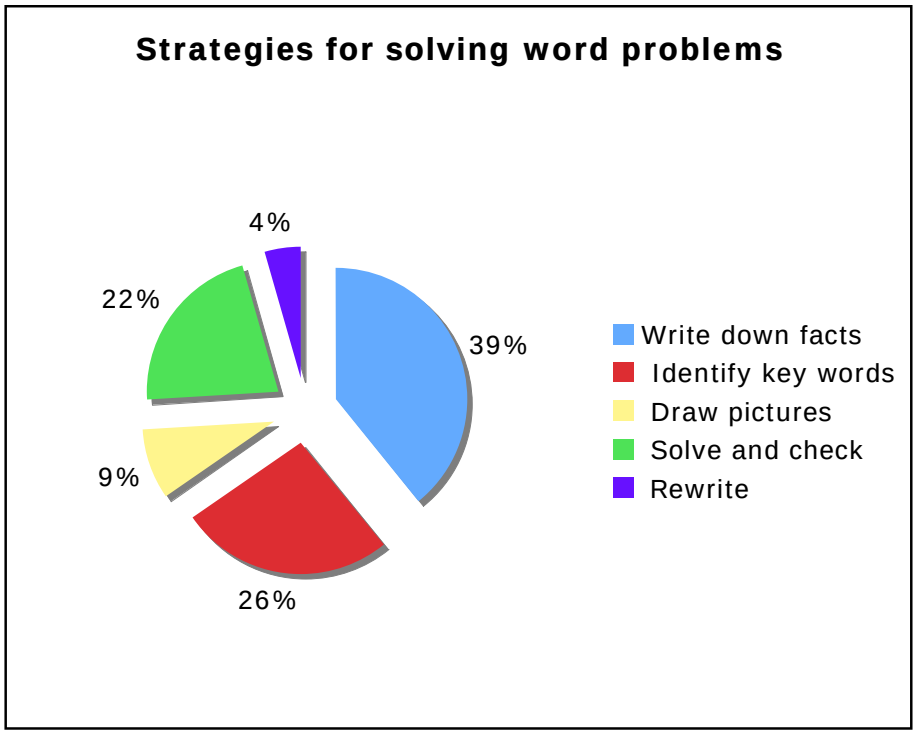
- Read – 18
- Decide on operation – 2
- Do the math – 1
- Moan – 1
- Put a label – 1



79% of the students read the problem again to find more information in order to look for information that will help them solve the problem.

The fourth question, “Please describe strategies that you usually use to help you solve math word problems.” solicited five typical responses:

- Write down facts – 9
- Identify key words – 6
- Draw pictures – 2
- Solve the problem and check – 5
- Rewrite as a number sentence - 1

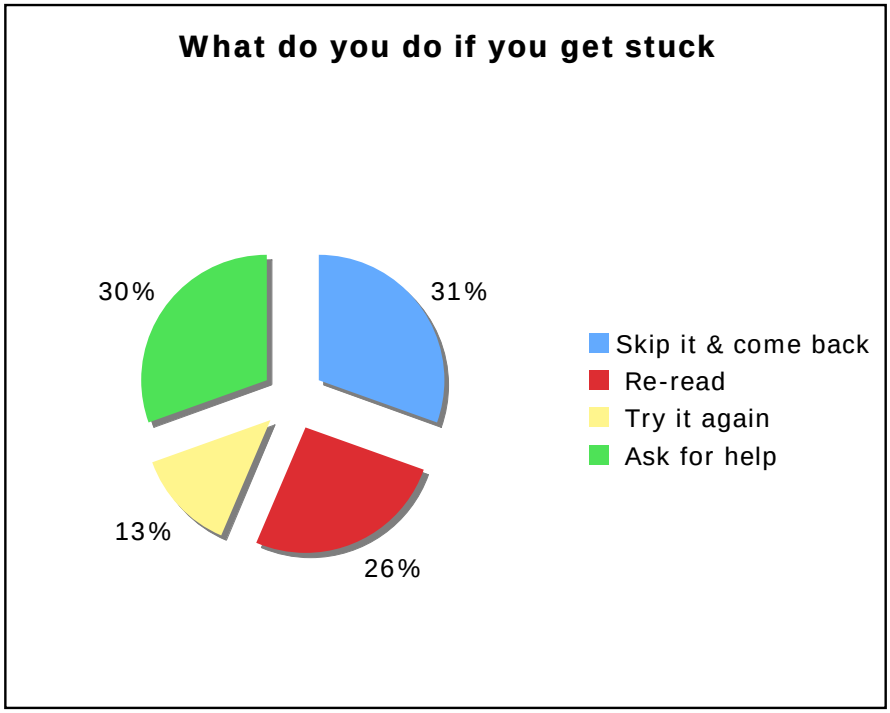


65% of the students try to identify the key facts of the question and use this information to solve the problem.

The fifth question, “What do you usually do if you get stuck on a problem?” solicited four typical responses:

- Skip it and come back – 7
- Re-read it – 6

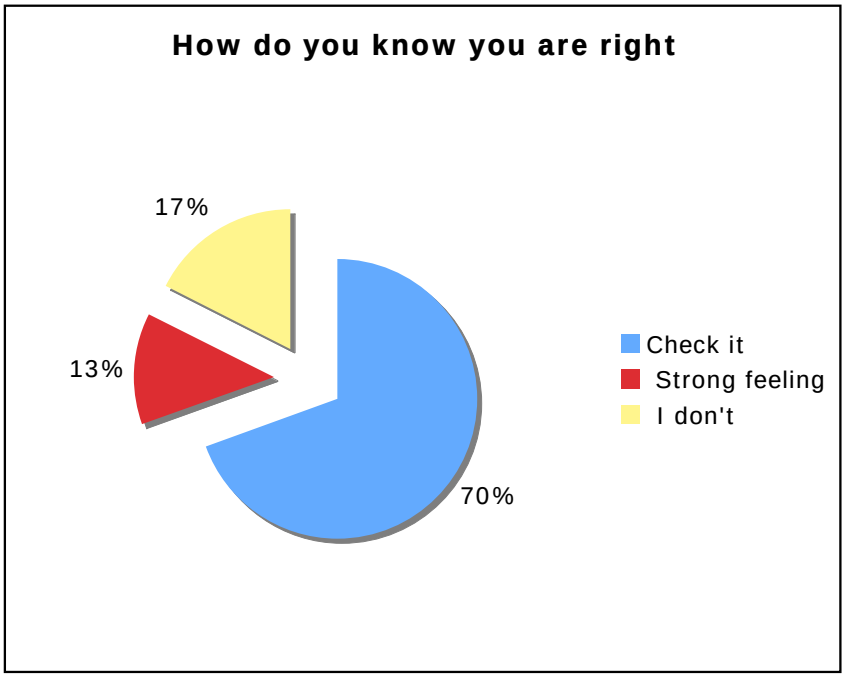
- Try it again – 3
- Ask for help – 7



61% of the students will either skip the question and come back to it or ask for help. Results show that students will search for an answer and try to find a method for a solution.

The sixth question, "How do you know when you get a problem right?" solicited three typical responses:

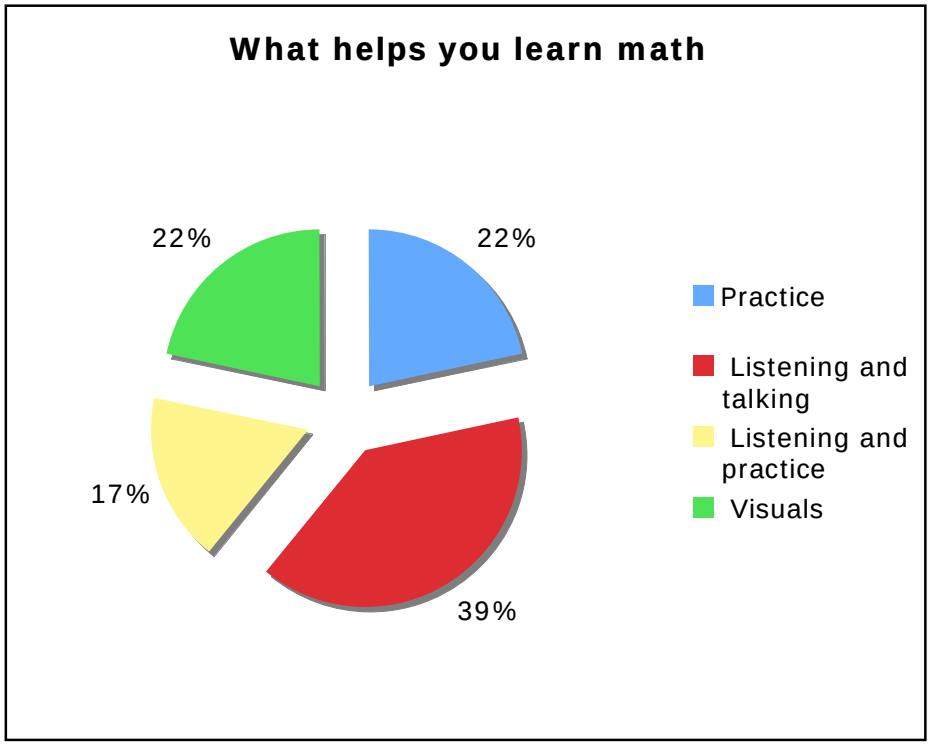
- Check it – 16
- Strong feeling – 3
- I don't – 4



70% of the students check their answer to verify if it is correct, 17% of the students do not know if their answer is correct and 13% base correctness on a feeling. This data leads me to question if students are able to solve problems consistently and are confident in their own ability to solve problems.

The seventh question, "What helps you learn math the best?" solicited four typical responses:

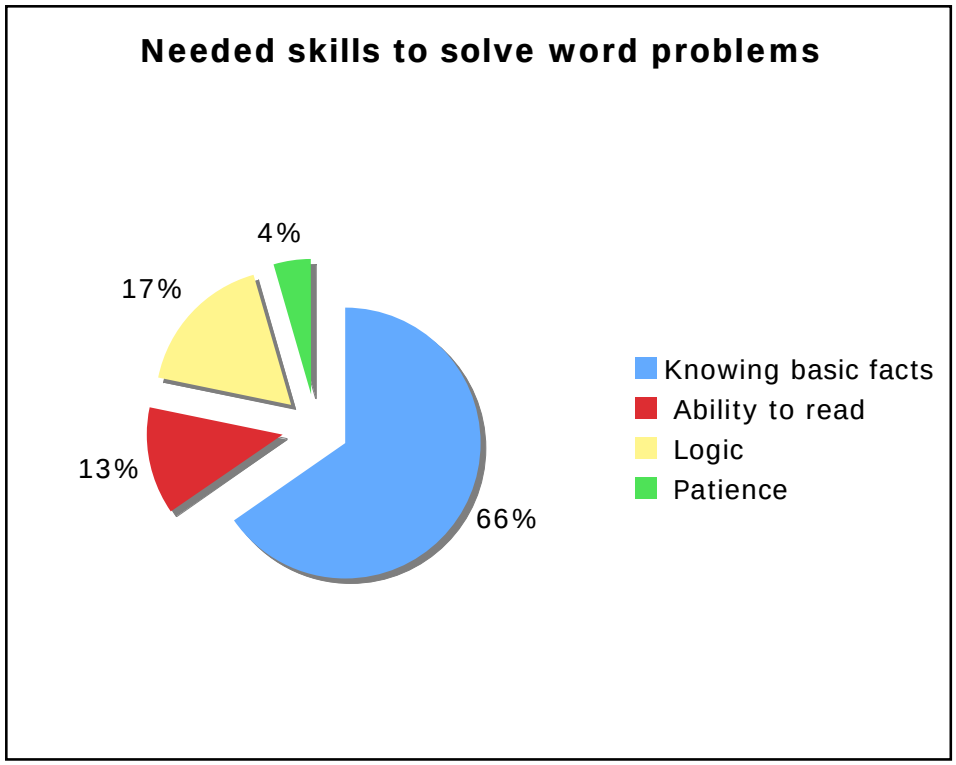
- Practice – 5
- Listening and talking – 9
- Listening and practice – 4
- Visuals – 5



78% of the students learn best by listening and talking along with practice. This would indicate that classroom interaction and discussion during problem solving benefits student learning.

Question eight asked, “What skills should a student have that will help him or her be successful at solving math word problems?” solicited four typical responses:

- Knowing basic facts – 15
- Ability to read – 3
- Logic – 4
- Patience – 1



66% of the students acknowledge they need to know their basic facts to solve problems. Homework and practice reinforce this skill.

I would assert that daily practice of math facts and application helps students problem solve consistently. Review of student journals indicates that knowing their basic facts is helpful when it comes to learning math concepts. JR said, "It was good to review our facts I saw improvement in my scores." Allison stated, "The review of multiplication and division was helpful in order to do advanced problems such as multiplying fractions." Homework supports building a strong fact background in mathematics. Student journals discuss how classroom activities and practice help them to learn new math concepts. Devan wrote, "I learned about order of operations. In order of operations you have to multiply and divide before you can add and subtract." Jana's journal said, "Today is Pi day. Pi is an irrational number. That means it goes on forever. It's improbable I think!" This indicates lesson design is important for student learning. My daily journal indicates that students are not able

to generalize previously learned skills to problem solving without practice. Practice in and out of class indicates higher achievement on quizzes and tests.

My second assertion is that students need to be able to discuss processes in math class with each other and with the instructor one on one. The students perform more consistently and with greater success when they have talked through how to solve a problem and which approach works best. Learning experiences that help math processes become more concrete include the asking of higher-level questions in class and providing adequate wait time. I would also assert that real-life situations like measuring lengths of items has been a benefit to helping recall of math processes to solve problems. I gathered evidence from my journal that students work well in class with the tools needed to solve measurement problems.

The students have had to respond to my questions and different math problems without my guidance to the answer. I have found that some of the students really dislike failure and challenge, however these experiences are precisely what helps them to remember and recall how to solve a problem.

Recently in class we had a discussion concerning $\prod$-day, March 14. 3.14 at 1:59 in the afternoon the combination of numbers is 3.14159 or the first six digits of pi. The discussion included my questioning and referring to other numbers we have discussed such as the $\sqrt{2}$ which led to the students concluding that these type of numbers are irrational. I was surprised that someone had remembered this since it had only been discussed once or twice this year. This indicated to me journaling and class discussions with several levels of questions being asked have an impact on learning. In my journal I indicated that on Feb. 28 I was beginning to see a payoff for relating previous experiences to current lessons. There are those students though, who cannot handle failure and challenge causing them to shut down.

"I don't get it so what's the use?" These are delicate students to handle. I have to try alternative questioning to engage their learning.

My observations and daily monitoring of student progress support that the activities that best help students learn math processes are still hands on work and homework. The students need to have experiences with the processes and be allowed to choose how to solve a problem and then show their work. This can be done in class and outside of class. Practical activities need to allow students to apply what they are learning and have learned previously.

Question seven from the survey that the students completed in class indicates that 78% learn best by listening and talking along with practice. Discussion is an important part of problem solving.

Another assertion I would make is that lesson design impacts the students' learning experience. Results from daily work, assessments, student journal writings, and answers to questions on the students survey indicate they learn best from practice and application. Recently we have ventured into some geometry, using measurement tools, drawing and measuring angles, and investigating integers. The students struggle, then take like fish to water. Perhaps my zest for them to learn outweighs their own enthusiasm.

The lessons I plan are not extraordinary. My delivery is! I approach how to present material with questions, burning questions. I want them to learn, and I want to learn with them. Delivery is key in my practice. Have you ever been sold something you really didn't intend to buy? It works if it is genuine and in their best interest! On April 25th I videotaped a lesson that was a problem students had to solve based on a television program they wanted to videotape while they were at school. The students worked in small groups trying to find out how long they should tape the program at different speeds so that they would tape the

program in the highest quality for the longest period of time possible. One of my students was extremely excited when he thought he had discovered an answer that worked. I was excited for him and this showed when I reviewed the tape of the lesson. I interact with the students and move about the classroom asking questions that cause deeper thinking from the students.

Several student interviews support that discussing problems in class and having time to practice problem solving helps them solve problems. In one interview a student noted, "I see how to work problems out, step by step." Another said, "When we work together I get to see the answer, it's easier than working alone." Knowing your basic math facts is also very important to problem solving, another student said, "Learning is easier when I know how to add, subtract, divide, and multiply." (see attachment F).

Students have a variety of ways to choose mathematical processes to solve problems. They think deeply about the question. When I interviewed students (see attachment E) they said they were thinking about the question and what it was asking. They then began to piece together what they knew from the questions. They worked what they knew, not trying to just find what they didn't know. I think I taught them this strategy. The next steps that I observed were the students trying to find something similar to a best fit. I asked them to tell me what they were doing as they solved a problem and why. Their answers were very logical and somewhat concrete. Remember we are talking about 11 and 12 year olds. They were asked to find an average of seven temperatures, 30% of a number, and if there were 6 cups in ½ gallon. I observed a lot of mental processing. Several responses in the survey I gave to the class were, "I just see if it makes sense." "I just know if the answer is right." "If I'm not sure then I try again, ask for help, or just figure, oh well!" This makes an interesting point. Trial and error and talking out their work seems to be an approach for many students.

I would like to believe they will not just trust their intuition and feelings in the future when designing a bridge for example, but learn to ask questions and find proofs.

When I interviewed my building principal, he felt that, "The most important elements in a math lesson include introduction, direct instruction, modeling, and relating the math to practical everyday use." He also went on to say that daily independent practice and feedback were important elements in a math lesson. Content knowledge was another element that my principal felt was important to math lessons. He stated that having a strong knowledge of the subject matter and being a creative instructor and a relationship builder with students added to their daily learning and retention of skills. "Student comprehension and application of math concepts is huge! Having a strong background in math and problem solving will help them further in life." (See attachment C)

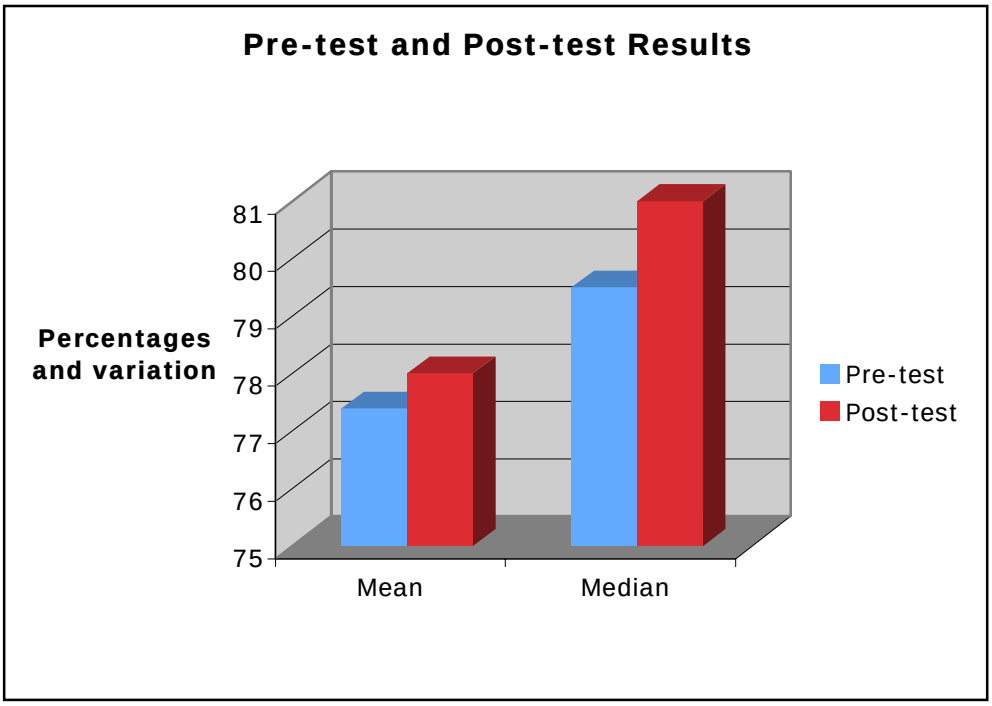
A final assertion is that assessment at the point of instruction does not promote retention. Earlier this year students were not using prior knowledge of place value to apply to the conversion of metric measurement. This took awhile for them to start using a skill in a new setting. My journals indicate that the students are challenged and are trying, but are not consistently using previous skills in new situations. April 17th entry, "While correcting test, multiple step problems, working with a fraction and multiplying then adding, students do not complete with more than 11% accuracy. Results from the assessment suggest problem solving is not easier near the point of instruction. 11/26 students had better scores from the pre-test to the post-test."(See Attachment D)

I find that the most effective learning experiences are those that include practice, application, and talking about how a problem was solved. My students have proven to me that assessment at the point of instruction is probably the best way to assess what they have most recently learned. However, when it comes to retention and problem solving, they need

to process. I have had the opportunity to interview seven students and all of them say that they do not like word problems (see attachment F). They stated that they are too hard, and they make you think. Are humans really inherently that intimidated by challenge or are they motivated by a need to complete the task quickly and be done with it? All seven students have also stated that practice and application help them learn best. They did a great job of listening to my questions. When I posed a problem, I asked them to process out loud and tell me how they were coming up with their solutions. One method they all used was logic. "Does my answer make sense to the question?" There was considerable mention about computation and being able to solve problems, they feel they learn best by practice.

I would also attest that after revisiting some journaling I did last fall that the students have had six months to grow developmentally. My entry from December 7, 2005, "Students do not read the entire problem or directions to choose a correct operation." December 8th I wrote, "Half of the students need help knowing what to do, especially word problems, they do not read the question." I feel that if I had conducted this research in the fall the results would be much different due to student growth and practice of learned math concepts. The students have had a great journey this school year and have learned a tremendous amount of information. The fact that they have grown developmentally contributes to their learning as well.

The students took a pre-test and a post-test that is an assessment that was created at an Educational Service Unit and is the assessment for problem solving used to report AYP (See Attachments D and E). The results from the first test given at the end of January had a mean score of 77.39, a median score of 78 and a standard deviation of 6.52. The second test given at the end of April had a mean score of 79.5, a median score of 81, and a standard deviation of 10.94.



The students have shown comprehension at the point of instruction as evidenced by homework, quizzes and unit tests but do not appear to have retained the skills. The results of the post-test indicated that if the problem contained multiple steps, involved fractions, or two forms of math (i. e.), multiply then add or subtract, students were not able to complete these problems with more than 11% accuracy. This was almost three months from the initial point of instruction with basic math facts, and addition, subtraction, multiplication and division of whole numbers, decimals, and fractions.

Students who were proficient or advanced on the pre-test according to cut scores ranging from beginning to progressing, proficient, and advanced did not digress in performance. Eleven of 26 students did make gains from proficient to advanced on the post-test according to the cut scores. The results from the assessment and daily work, quizzes, and unit tests suggest that problem solving is the easiest at the point of instruction. There were gains of 42.3% by this student population nearly three months after instruction of basic

math facts from one proficient level to the next, specifically from proficient to advanced. These test results could be attributed to developmental growth or classroom instruction.

The instruction in class continued to challenge the students in areas that required them to apply previously learned skills and relate the skills to concepts such as expanded notation, powers of ten, the use of exponential power and basic forms of geometry. I have worked with this group of students for eight months and their cognitive reasoning skills have developed dramatically in this time. The age group of 11 – 12 year olds experiences significant growth, physically and developmentally and the results from the pre-test to post-test provide evidence that the period of growth produced mental development that enabled the students to think more deeply about problem solving.

INTERPRETATION

What do all of these assertions add up to? This study tells me that problem solving is difficult for students. They have a difficult time generalizing from one situation to another. Students struggle with determining which mathematical process they should use to solve a problem. If problems are multi-step, they have a very low rate of success in finding the correct answer. Students perform well on quizzes when I assess at the point of instruction, but assessment at the point of instruction does not promote retention. Students did score better on the post-test given nearly three months after much of the instruction was completed for skills necessary to solve problems on the assessment. I do not think that this study indicates the retention of problem solving skills and the point of instruction have an effect on student performance. When an assessment for problem solving is given really does not affect outcomes if the students have been taught the skills necessary to solve problems. This study tells me that story problems can be solved systematically using basic mathematics, but that is

not truly problem solving. This study tells me problem solving needs to allow challenge and stretching of the students' thinking and discovering solutions.

This study tells me that I am a good observer of how my students perform daily. I have determined that they need good instruction that builds on prior knowledge and supports their learning by requiring them to recall what they have already learned and how it relates to new concepts. Good teaching helps children learn and problem solve. The students are eager to learn and want to know new things but are not fond of word problems. The data tells me that they are able to perform well when they are challenged. Habits of the Mind type problems are fun for students, they enjoy trying to solve problems like these. I think more problems, perhaps one per week, would be good practice, and I plan on implementing that practice in my classroom next year. Students use good strategies, conversation, and writing to solve problems. Time, exposure to curriculum, practice, speaking and listening, and challenge all help students to become better problem solvers.

Next school year the action I would like to take is to reorganize the 6th grade math curriculum so that it is taught with more continuity. I have a scope and sequence that was used this school year and I was very comfortable with the pacing and content and when each concept was taught. Eighty-five percent of the students I taught this year met the standard for AYP. There are no results for the previous year because there was no reporting for AYP. The sequence builds upon prior experiences and allows students to become better problem solvers. There will be three teachers teaching math in the 2006 – 2007 school year in the 6th grade and this continuity would support learning and problem solving. My administration has asked me to submit a plan with rationale before the end of this academic year so that it can be discussed at district curriculum meetings this May.

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Attachment A

MONTH	MATH	GEOGRAPHY
AUGUST	Drill basic facts +, -, x, ÷ Ch. 2 types of numbers, place value, rounding 8.1.1	Map skills, Lat. And Long. Landforms, 5 themes chapters 1 – 4
SEPTEMBER	GCF, LCM, division Ch. 7 8.1.4, Equivalencies, fractions, Decimals, percents Ch. 3 – 4, 8.1.2	Continue through Unit 1 and transition to Europe, foods, culture.

SEPTEMBER	GCF, LCM, division Ch. 7 8.1.4, Equivalencies, fractions, Decimals, percents Ch. 3 – 4, 8.1.2	Continue through Unit 1 and transition to Europe, foods, culture.
OCTOBER	+, -, x, ÷ of whole numbers, decimals, and fractions. Ch. 4,7,8 begin CRA 8.2.1 given in parts.	Europe and relief maps
NOVEMBER	8.2.1 continue from October work with expended form Ch. 3, 8.1.3	Asia, SW and central
DECEMBER	8.2.1 continue and reinforce fractions,	South Asia
JANUARY	Continue with 8.2.1, ratios and proportions, Ch. 6, 8.2.3	S. and SE Asia, East Asia and the Chinese New Year
FEBRUARY	Order of operations and problem solving Ch. 1 and 2 8.2.4, and 6.2.2	Finish East Asia move to Australia, N. America and Canada
MARCH	Estimation and problem solving, measurement 8.2.5, 8.3.1	N. America US states, capitals, flags
APRIL	Geometry Ch. 9 – 10, 8.4.1 Coordinate graphing with negative integers Ch. 11 8.6.1	Mexico and Central America, Caribbean Cinco de Mayo, Pinatas
MAY	Equations, variables, enrichment, mean, median, mode, Ch. 5,6,12, Pre-al diagnostic test	S. America and Africa to Antarctica

MATH AND GEOGRAPHY SCOPE AND SEQUENCE GRADE 6

ATTACHMENT B

Cobelens
Student Problem Solving Survey

Directions: Please complete this survey as completely as possible. **DO NOT** put your name on the survey. All answers are anonymous and will remain confidential. Your opinions about Math will help plan Math lessons that are more meaningful to students and learning Math concepts.

1. What words would you use to describe your feelings when you get a math assignment that is mostly word problems?

2. React to the following statements by marking your level of agreement or disagreement with each. Circle the number that best describes your feelings or opinions.

    a. My teacher takes time to make sure I understand the Math lesson.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(1)	(2)	(3)	(4)	(5)

    b. I feel successful in Math class when I complete homework, quizzes, and tests.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(1)	(2)	(3)	(4)	(5)

    c. I have Math homework at least 3 days a week that I complete in 30 minutes or less.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(1)	(2)	(3)	(4)	(5)

    d. I learn Math concepts pretty easily.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(1)	(2)	(3)	(4)	(5)

    e. Math problems have one correct answer.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(1)	(2)	(3)	(4)	(5)

    f. There is only one way to get the right answer to Math problems.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(1)	(2)	(3)	(4)	(5)

g. Knowing basic facts helps students solve word problems better.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(1)	(2)	(3)	(4)	(5)

3. What is the first thing you usually do when you see a math word problem?

4. Please describe strategies that you usually use to help you solve math word problems.

5. What do you usually do if you get stuck on a problem?

6. How do you know when you get a problem right?

7. What helps you learn math the best?

8. What skills should a student have that will help him or her be successful at solving math word problems?

Attachment C

QUESTIONS FOR PRINCIPAL INTERVIEW

1. What do you think are the most important elements in a Math lesson?

2. What characteristics do you think make a person a good math teacher?

3. How much homework and practice is appropriate for middle level students in Math?

4. What are the most important skills a student should gain from Math class?

5. How should a teacher of Math assess and determine best practices for teaching Math lessons?

6. How should a teacher of Math assess and determine student comprehension and success in Math class?

7. How important is teacher knowledge of subject material?

8. How important is student comprehension and application of Math concepts?

9. Is there anything you want to ask me?

10. Is there anything you want to add to give me a better picture of your beliefs about teaching math?

Attachment D

Math Assessment

Title:	**Solving word problems with correct operation.**
Grade/Content Area:	**6th Grade Math**
Team name & Number:	**6th #3**
Standard #:	**8.2.2**
Standard:	**By the end of eighth grade, students will identify the appropriate operation and do the correct calculations when solving word problems.**

Brief Description of Assessment:

Students will demonstrate their ability to solve word problems using the correct operation.

Materials Needed:

Paper
Pencil

Accommodations:
As identified on a student's IEP, 504 plan or as prescribed by the Student Assistance Team.

Quality Indicator #1: Assessments reflect the state standards.
Describe how the panel matched the assessment to the standards.

Describe how the panel determined that sufficient coverage or score points were present, including how all four proficiency levels are included.

Quality Indicator #3: Assessments are free from bias or offensive language or situations.
___x__ **Bias checklist completed**
Describe changes made as a result of the bias review.

Quality Indicator #4: Assessment levels are appropriate for students.
Describe the professional judgment process you used to review items to make sure they were at an appropriate level.

Describe changes/modifications made based on this review

__6.7___ **Analysis of readability level was run.**
Describe the results and any changes made.

Quality Indicator #5: There is consistency of scoring.
Suggested method(s) to determine. (Reliability is determined after the assessment is administered and scored.)
_____KR 20/Coefficient Alpha (computer analysis for objective assessments)
_____Decision Consistency Method (for objective and/or subjective assessments)
_____Teacher Re-scoring (for subjective assessments)

Quality Indicator #6: The mastery levels are appropriate.
Method used to determine mastery: ____Modified Contrasting Group Method
___x_Modified Angoff Method

Angoff results:
Advanced: 24 - 28
Proficient: 16 - 23
Progressing: 9 - 15
Beginning: 0 - 8

Directions for Administering Assessment:

This assessment may need more than one class period to administer and hand out one assessment to each student. Be sure each student has a sharpened pencil and scratch paper. Read the following directions aloud to the class. *You will be completing a math standards assessment over Standard 8.2.2. in which you will be solving word problems. Read each problem carefully. You will have this math period to complete this assessment. When you are finished, please raise your hand and I will collect your test.*

Assessment (Include scoring rubric if appropriate): Standard 8.2.2 (Pre-test)

Name_____
Date_____

Directions: Read the following questions carefully. Solve.

1. **Troy wants to buy a computer printer costing $395. In April he saved $35. How much more must he save so that he can buy the printer?**
   _____

2. **One of the tall buildings in the center of the city has 22 stories. The height of each story is 11 ft. How tall is the building?**_____

3. **The reported attendance figures for three baseball games were 500, 300, and 260. What was the total attendance for the three games?**_____

4. **How many streamers, each 1.5 meters long, can be cut from a roll of crepe paper 36 meters long?**_____

5. Jenny wants to join a health club that charges $12.50 a month. In addition to her monthly charges, she must pay a one-time initial fee of $40. If Jenny joins the club for one year, what is her total cost?

_____

6. On Saturday night, the video store rented 54 dramas, 16 westerns, 27 science fiction movies, and 39 comedies. Together, how many drama and comedy videos were rented? _____

7. Tony and Maria are selling pieces of pizza at the school concession stand. Each pizza is cut into 8 pieces. Tony sold a total of 11 hamburger pizzas. Maria sold 14 cheese pizzas. How many total pieces of pizza were sold? _____

8. Anita is sorting ornaments into storage boxes. She has 6 boxes. Each box can hold 4 rows of 12 ornaments. How many ornaments can Anita store in all of her boxes?_____

9. Mitch is practicing for a piano recital. He practices 30 minutes on the first day, 40 minutes on the second, 50 on the third, and 60 minutes on the fourth. If he continues this pattern, how many minutes will he have practiced in all at the end of 7 days?_____

10. Hank buys 3 country-western CD's for $14.79 each. He hands the clerk 3 twenty dollar bills. How much change should he receive?

_____

11. John had 30 goldfish in his aquarium and gave 13 goldfish to his friend Billy to start his own aquarium. How many goldfish does John have left_____

12. Ann made 36 cookies. Her dog ate 12 of them. How many did she have left? _____

13. Jim ran 4 miles a day for 7 days. How many miles did he run in all?
_____

14. Tim had 5 packages of baseball cards. Each package contained 9 cards. How many cards did Tim have in all?
_____

15. Jane has 36 markers, 15 colored pencils, 6 pens, and 8 pencils. How many writing instruments does Jane have?
_____

16. During a rainstorm, the water level of a creek rose 2/3 ft. Then it rose another 1/2 ft. How much did it rise in all?
_____

17. Pat's apple tree produced 2 3/4 bushels of apples and John's produced 1 1/4 bushels of apples. How much more fruit did Pat's tree produce? _____

18. If a raisin weighs 1.2 g., about how many raisins are in a box that contains 123.6 g. of raisins? _____

19. At $0.86 per pound, what will 2.5 pounds of peaches cost?
_____

20. A family traveled 58 miles the first day, 136 miles the second day, and 167 miles on the third day of their trip. How many miles have they traveled in all? _____

21. John had 216 apples. How many baskets would he need if he put 24 apples in each basket? _____

22. Jim made 13 pizzas. He used 16 ounces of cheese on each pizza. How many ounces of cheese did Jim need?
_____

23. We're on a trip of 250 miles. We've gone 75 miles. How many miles are left on our trip? _____

24. A sixth grade class has 95 students. If the students are equally divided among 5 teachers, how many students are in each class?

_____

25. Sam ordered 6 boxes of candy bars for the concession stand. Each box contains 12 candy bars. He sold 3 boxes. How many candy bars does he have left? _____

26. In Chris' last 4 basketball games, he scored 21, 14, 9, and 20 points. What are the average points per game scored for Chris?

_____

27. Looking at Van's Vet Clinic boarding schedule, how many animals did they have at the closing on Wednesday?

_____

Van's Vet Clinic

Day	Admit	Went Home
Monday	6	0
Tuesday	8	4
Wednesday	13	5

28. Jill made 21 dozen cookies for the bake sale. She put 14 cookies in each box. How many boxes of cookies does Jill have for the sale?

_____

Answer Key: Standard 8.2.2 (Pre-test)

1. $360

2. 242 feet

3. 1,060

4. 24 streamers

5. $190

6. 93 videos

7. 200 pieces

8. 288 ornaments

9. 420 minutes

10. $15.63

11. 17 goldfish

12. 24 cookies

13. 28 miles

14. 45 cards

15. 65 writing instruments

16. 1 1/6 foot

17. 1 ½ bushels

18. 103 raisins

19. $2.15

20. 361 miles

21. 9 baskets

22. 208 oz.

23. 175 miles

24. 19

25. 36 candy bars

26. 16 points

27. 18 animals

28. 18 boxes

Attachment E

Math Assessment

Title: **Solving word problems with correct operation.**

Grade/Content Area: **6th Grade Math**

Team name & Number: **6th #3**

Standard #: **8.2.2 (Post-test)**
Standard: **By the end of eighth grade, students will identify the appropriate operation and do the correct calculations when solving word problems.**

Brief Description of Assessment:
Students will demonstrate their ability to solve word problems using the correct operation.

Materials/Resources needed:
Paper
Pencil
A calculator may be used.

Notes for teacher:
Encourage students to use labels, but do not deduct points if a label is not used.

Estimated time to administer: 60 minutes

Rubrics are included with the answer key.

Possible accommodations:
As identified on a student's IEP, 504 plan or as prescribed by the Student Assistance Team.

Possible modifications: dependent on student and IEP

Instructions given to Students/Directions for administering assessment/Prompts/Examples given:

Directions for Administering Assessment:
Write your name on the test.
Solve the problems. You may use a calculator. Please remember to label your answers.

Angoff results:

	Beginning	Progressing	Proficient	Advanced
Range	**0-11**	**12-17**	**18-26**	**27-32**
Points in Range	**12**	**6**	**9**	**6**

Directions for Administering Assessment:

This assessment may need more than one class period to administer. Hand out one assessment to each student. Be sure each student has a sharpened pencil and scratch paper. Read the following directions aloud to the class. *You will be completing a math standards assessment over Standard 8.2.2. in which you will be solving word problems. Read each problem carefully. You will have this math period to complete this assessment. When you are finished, please raise your hand and I will collect your test.*

Assessment (Include scoring rubric if appropriate): Standard 8.2.2 (6.2.2 Post-test)

Name_____
Date_____

Directions: Read the following questions carefully. Solve.

1. **Tim wants to buy a DVD player costing $265. In June he earned $50. How much more money must Tim earn so he can buy the DVD player?**
   _____

2. **The basketball team is buying pizzas for a team meeting. If one pizza has 12 slices and they buy 14 pizzas, how many slices will they have in all? _____**

3. **A school has 420 fourth graders, 400 fifth graders, and 430 sixth graders. What is the total number of students in all three grades?**
   _____

4. **How many pieces of string, each 2.5 meters long, can be cut from a roll of string 60 meters long?_____**

5. **Shelby wants to join a book club that charges $7.50 a month. In addition to her monthly charges, she must pay a one-time initial fee of $20. If Shelby joins the club for one year, what is her total cost?**
   _____

6. On Saturday, the library loaned 32 non-fiction, 24 fiction, and 16 picture books. What was the total number of books loaned on Saturday? _____

7. Zach and Sydney are selling pieces of pie at the school concession stand. Each pie is cut into 6 pieces. Zach sold a total of 12 apple pies. Sydney sold 16 cherry pies. How many total pieces of pie were sold?
_____

8. Amanda is sorting cans of pop into storage boxes. She has 8 boxes. Each box can hold 6 rows of 8 cans of pop. How many cans of pop could Amanda put into the storage boxes?

_____

9. Mitch is practicing for a band concert. He practices 15 minutes on the first day, 30 minutes on the second, 45 minutes on the third, and 60 minutes on the fourth. If he continues this pattern, how many minutes will he have practiced in all at the end of 7 days?_____

10. Ryan buys 4 DVD's for $19.95 each. He paid the clerk with 4 twenty dollar bills. How much change should he receive?_____

11. Pete had 50 toy cars in his collection and gave 12 cars to Sam to start his own collection. How many cars does Pete have left?
_____

12. Chris started school with a box of 48 crayons. Chris lost 14 of them during art class. How many crayons does Chris have left?

_____

13. Pat bought 9 packages of gum. Each package has 5 pieces of gum. How many pieces of gum did Pat buy? _____

14. Juan had 3 CD's with 8 songs on each CD. What was the total number of songs Juan had on his CD's? _____

15. Bob has 30 tennis rackets, 12 golf clubs, 6 soccer balls, and 3 footballs. How many pieces of sports equipment does Bob have?

_____

16. On Monday during a snow storm, it snowed 1/3 of a foot. Then on Tuesday it snowed another 3/4 of a foot. How much did it snow in all?_____

17. Jan bought 3 1/4 bushels of corn and Jim bought 6 3/4 bushels of corn. How many more bushels of corn did Jim buy?

_____

18. If a peanut weighs 1.3 grams, how many peanuts are in a can that contains 224.9 grams of peanuts?

_____

19. At $0.79 per pound, what will a 5 pound watermelon cost?
_____

20. Diane put 48 pictures in her photo album on Monday, 129 pictures on Tuesday and 176 on Wednesday. How many pictures are in her photo album? _____

21. Amy had 108 pencils. How many packages of pencils would Amy have if there were 12 pencils in each package? _____

22. Maria did 15 math problems each day for 15 days. How many math problems did Maria do? _____

23. A store has 275 shirts. The store sold 86 shirts. How many shirts does the store have left? _____

24. A marching band has 80 students. If the students are equally divided among 8 rows, how many students are in each row?
_____

25. Tyler ordered 10 cases of Powerade for the concession stand. Each case contains 24 bottles. He sold 6 cases. How many bottles of Powerade does he have left?_____

26. Morgan has scored a 95, 89, 88, and a 100 on her last 4 math quizzes. What is her average score for the four quizzes?

_____

27. During the week there were several students absent from the math class. There are 25 students enrolled in the class. On Monday 3 students were absent, on Tuesday 4 students were absent, Wednesday 6 students were absent, and on Thursday there was 1 student absent. Friday's class was full. How many total students attended math class during the week?

_____

28. Rockie made 14 dozen donuts for the bake sale. She put six donuts in each box. How many boxes of donuts does Rockie have for the sale? _____

29. A hospital has 78 patients. During the day 6 more patients arrived. How many patients does the hospital have now? _____

30. There are 365 days in a year. How many days are there in 3 years?

_____

31. Your reading assignment is to read 480 pages from your book. You have 5 days to read. How many pages will you need to read each day? _____

32. The student council has raised $129.95 for new benches in the halls. The materials cost $66.80. The carpenter will charge $100.00. How much more money does the student council need to raise? _____

Answer Key: Standard 8.2.2 (Post-Test)

1. **$215**
2. **168 pieces**
3. **1,250 students**
4. **24 pieces of string**
5. **$110**
6. **72 books**
7. **168 pieces**
8. **384 can of pop**
9. **420 minutes**
10. **$0.20**
11. **38 cars**
12. **34 crayons**
13. **45 pieces of gum**
14. **24 songs**
15. **51 pieces of sport equipment**
16. **1 1/12 foot or 1 foot 1 inch or 13 inches**
17. **3 ½ bushels or 3 2/4 bushels or 3.5 bushels**
18. **173 peanuts**
19. **$3.95**
20. **353 pictures**
21. **9 packages**
22. **225 math problems**
23. **189 shirts**
24. **10 students**
25. **96 bottles**
26. **93 percent**
27. **111 students**
28. **28 boxes**
29. **84 patients**
30. **1,095 days**
31. **96 pages**
32. **$36.85**

Attachment F

QUESTIONS FOR STUDENT INTERVIEW

1. How much Math homework do you have each week?

2. What type of things have you learned in Math that help you in Math class?

3. How successful do you feel about using Math skills in and out of class? Give an example of how you use Math outside of class.

4. What do you think about when your teacher asks questions during Math class?

5. What do you like best about Math? What do you like least about Math?

6. I would like you to work on these three problems, saying aloud whatever it is you are thinking as you work through the problems. I especially want to hear you talk about how you decide what to do to solve the problems.

   a. During the month of December, which has 31 days, it snowed 30% of the time. How many days during December did it snow?
   b. Making a recipe requires certain amounts of ingredients. You have one half gallon of milk and you need 2 cups of milk for use in three different recipes. How much total milk will you need and do you have enough milk with ½ gallon?
   c. For the first week of December the temperatures in celcius were 8.4°, 7.5°, 5.1°, 9.0°, 8.1°, 7.9°, 6.7°. What was the average temperature in Celsius for the first week of December?

7. Is there anything you want to know from me?

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