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What happens when students learn a step-by-step approach to solving math word problems?

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WHAT HAPPENS WHEN STUDENTS LEARN A STEP-BY-STEP APPROACH TO SOLVING MATH WORD PROBLEMS?

by
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A Thesis

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

Introduction

Every year as students progress through school, the word problems follow them and become harder and harder. It is important to teach the students at a young age the skills that they will need to solve the word problems efficiently. "Solving word problems in math involves a complex web of skills that require learners to be good readers and to be proficient at thinking critically, computing, and using a process to solve problems" (Forsten, 2004, p. 20). In this study, I went back to the basic reading comprehension strategy to show the students how to analyze the word problems. The selection of an appropriate strategy was critical for the student's abilities to successfully answer the problems given. Throughout this study there were many opportunities for the students to build on their knowledge and ask questions every step of the process.

Statement of the Problem

During my first week at my placement I was able to jump right in and help out in math. Right from the beginning I saw many students struggling to keep up and follow the lesson being taught. It wasn't because of lack of concentration and focus, but of making the connection to previous taught lessons. The problem in this particular class is retaining the strategies learned from chapter to chapter. In the classroom, a thirty minute lesson will take an hour because they struggle to remember which strategy to use to solve the problem best. I looked over the first test given while I was there to see where the major

problem was for them. I noticed that earlier in the test the understood the concept, but when it was written in a word problem they were not able to complete it. I then decided the problem I would be focusing on with the students would be connecting what they have learned and applying it when it is written in a word problem.

Though my focus is solving math word problems, reading comprehension is an essential skill that students must have to be able to begin to tackle the problem. Students need to have certain skills that they learn in language arts that are important to solving word problems. The students need to be good readers, be proficient at critical thinking, and be able to compute the numbers.

When I first met with my cooperating teacher we discussed our backgrounds and what subject we prefer to teach. We both agreed that math was our favorite subject and really enjoyed teaching math. She told me that the class she has this year really struggles with the subject and it would be great for us to work together to enrich the students. I was really interested when I found out that the class I would be in struggled with math, because that is where I am strongest and feel most comfortable in. I was able to look at one of their tests and saw that they were asked to write and solve word problems; which many of them struggled with. As a student, I never cared too much for word problems because I feel I was not taught the right strategies to solve them. I believe that if they are not taught how to properly complete these problems they will struggle throughout their years in school because they come up every year you take a mathematics class.

Significance of the Study

After getting to know the kids and learning more about where they struggle I thought that it would be important to focus on something that will benefit the students

most. This class was very strong in language arts and writing, but they needed help with math. Being that fourth grade is a very important year for testing with the NJ ASK I thought it would be great to try to bring their scores up in that subject area. Picking an area like problem solving was something that I felt was very important and something they will use each year in school.

Question

During my action research, the question that guided my study was: What happens when students learn a step-by-step approach to solving math word problems?

Integrated Action and Purpose

In my action research project, I wanted to focus on improving the students' skills in solving mathematical word problems. I began by giving the students a questionnaire on problems solving (see appendix C). After reviewing the questionnaire, I was able to see what the issue was when it came to trying to solve the problem. After the questionnaire, I taught a lesson on problem solving. As a class we reviewed the steps they were asked to follow. A poster was posted on the wall so it was always in sight if they needed a reminder. Next to that poster was another poster that had different strategies they could use to solve the problems. The rest of that day we did a couple problems together as a class out of their text books. I introduced a new way for them to solve problems and we practiced it so for the next step in my research they would understand how to do it without a lot of unnecessary questions.

When the students came in every morning they usually had some kind of activity for them to complete while everyone was unpacking and getting settled for the day. I took great advantage of this time to implement my research. I went through multiple textbooks and other resources my cooperating teacher had in the classroom and re-typed them up in

the format that we practice so it was familiar for them. Each morning the students came in and completed the problem for the day. During this time, I was able to walk around and answer any questions they might have and I kept a journal for myself. I gave the students about fifteen minutes to complete it and then we discussed it. The students were able to talk through the way they solved it and students were able to see different strategies used to solve the same problem.

After a week of doing these problems in the morning, we took a class period during math and worked together in their table groups already arranged. It was a review for their upcoming test, and I wanted to take what they learned and put into a word problem. This time they didn't have a worksheet set-up with the questions they were supposed to answer. All they students had were their notebooks and the question given. Each table had their own problem and they were given ten minutes to answer it. Once the ten minutes were up they would move as a table to the next question. They moved for a total of five times around the classroom. Once they were finished we had someone from each group come up and explain to the class how they solved the problem. The students really seemed to like this and it was very beneficial for the preparation of their upcoming test and for my research.

Assumptions and Limitations

Before starting this study, I assumed that the students would find the steps really easy to follow and it would help. Little did I know they worried so much about making sure they completed each step that they didn't understand the problem any better. Also, I thought that I would see more students understanding the problems and it would be less stressful when they saw a word problem.

In this study, I did a lot of the work during the morning when they first came in as their "morning work". I took a couple days to teach the strategies and the step-by-step process to solving word problems, but for the most part the students did the work in the morning. This worked out perfectly for me because everyone came into the classroom and begun working on it. If there were any questions from the students there were two teachers that were able to walk around and help. My cooperating teacher was there to help whenever I needed her throughout this research that someone may not have as a resource. By having the extra time in the morning to give assignments for them to complete and the extra help in the class to meet with individuals was really beneficial, but something someone else may not be able to do while completing the research.

Definitions

Action research is any systematic inquiry conducted by teacher researchers, principals, school counselors, or other stakeholders in the teaching/learning environment to gather information about how their particular schools operate, how they teach, and how well their students learn (Mills, p. 5, 2007).

Step-by-step approach is when the students are introduced to prompted questions they need to follow to answer the questions. The steps given to the students were; A) Read and Understand- 1. What do I know? 2. What do you need to find out? B) Plan and Solve- 1. How will you solve it? 2. What strategy will you choose? C) Solve – answer the question in a full sentence. D) Look back and check- 1. Did you solve the problem that was asked? 2. Did you answer all parts of the problem?

Information processing is the coding, retrieval, and combination of information in perceptual recognition, learning, remembering, thinking, problem solving, and performance of sensory-motor acts (Unknown, 2009).

CHAPTER II

Literature Review

Problem Solving Comprehension

Students who struggle with reading comprehension skills cannot understand the language of a math word problem. In conjunction with this, students may not have been exposed to enough strategies that may help them correctly solve the word problem. VanSciver (2009) believes that bridging the gap between understanding a question and knowing how to solve it is a key step to helping students demonstrate knowledge (p 26). In every subject, whether it is science, math, or English, student's assessments deal with comprehension of the literacy and their ability to decode the meaning of the words. If students cannot understand what the word problem is asking them or do not understand the point of the word problem, they cannot answer it correctly. "Solving word problems in math involves a complex web of skills that require learners to be good readers and to be proficient at thinking critically, computing, and using a process to solve problems" (Forsten, 2004, p. 20).

Strategies

It is very evident that there is diversity with different types of learners in the classroom. Especially in mathematics, students need to be shown different approaches to solving a problem. Students who are visual learners would benefit from using manipulatives, and other visual aids that would strengthen the understanding of that concept and skill. According to Forsten (2004), doing daily math warm-ups helps to build vocabulary, concepts, and skills (p 23).

Taking a step-by-step approach to solving word problems allows the teacher to help the students organize the information into a simple graphic organizer, which is more manageable. The students should be able to dissect the problem and organize it in a fashion that works best for them (pictures, words, numbers, charts, guess and check, or work backwards). When starting to teach the students about this strategy, it is important to make sure the problem fits their readiness and computation level. "Teaching strategies doesn't work if they are used only now and then. Students must see the need for the strategies and have numerous opportunities to practice using them" (Forsten, 2004, p 23). Justice and Oliver-Hoyo (2008) believe in the strategy called "GOAL", which stands for gather, organize, analyze, and learn (p 62). The first three steps are meant for what they stand for, but learn is something different than what others have found to work. Learn has two benefits; "…it gives students a chance to see if the answer makes sense in the context of the question…and it serves as a way to encourage students to make use of higher-order cognitive skills…" (p 62). Like Justice and Olvier-Hyo, "Pólya's four-step problem-solving model includes the following stages: (a) understand the problem, (b) devise a plan, (c) carry out the plan, and (d) look back and reflect" (Griffin & Jitendra, 2009, p 187). Both strategies have the students organizing their information, implementing what they know, and going back to reflect on their problem to make sure it makes sense.

In Singapore, they use a bar model approach when it comes to solving math word problems. This method is first introduced to third graders and is continually used throughout students' schooling. When students are given a word problem they are not confused to what to do; they know to use the bar model because that is all they have ever

known. Bar models are not just used to represent by showing a picture, but also to show it symbolically. "Singapore Math is able to teach at a slower pace and in more depth because it focuses instruction on the essential math skills recommended in the Curriculum Focal Points" (Garelick & Hoven, 2007, p 31).

Tips to Reduce Problems Caused by Words and Contexts

Every teacher has a specific curriculum that they need to follow for the school year, so their students meet all the requirements. Trying to figure out what strategies or procedures to implement so every student learns to their fullest can be difficult. Bahr, Monroe, and Panchyshyn (2006) state that it is very important to teach the vocabulary in every lesson taught just as you would in any literacy lesson (p 4). It is imperative to allow students enough time to explore the concept presented to allow for alternative solutions, and not to assign excess work to go along with every new skill learned. Being able to tweak word problems to personalize them to the student's names, places they are familiar with, or activities they are interested in will enhance their interest in the problem. Forsten suggests that by incorporating their literacy books read in class, the teacher can take the setting, characters, and situations to form a word problem that the students can relate to (Bahr, Monroe, & Panchyshyn, 2006, p 4). One last tip given by Bahr, Monroe, and Panchyshyn is to encourage the students to write their own word problems (p 5).

Word Problems Integrated in Other Subjects

To continue the process of understanding problem-solving it is important to integrate both reading and mathematics together to reinforce the skills learned. Bringing reading into word problem solving, helps by teaching the students how to actually read the problem correctly and shows the students a method of highlighting and identifying

key information they need to solve correctly. On the contrary, VanSciver (2009) feels that English teachers will be resistant, because they feel they should not have to do the math teacher's job, and they may have a fear of solving the problems themselves (p 28). Hyde (2007) states that reading and math should be brought together, and be able to incorporate reading comprehension cognitive strategies with math cognitive processes (p 44). For example, taking a commonly known strategy like K-W-L and putting a math twist on it so it is now K-W-C. The "K" for reading meant what do I know, and now is used as what I know for sure. The "W" in reading stood for what do I want to learn about, which was adapted to be what I want to find out. Finally the "L" in reading represented what do I want to learn which was changed to, are there any special conditions, rules, or tricks that I have to watch out for. This strategy was modeled for the students and then they were able to work on problems following the structure of K-W-C.

A strategy that some students find to be useful is drawing a picture to solve the problem. Incorporating art into math and vice versa helps problem solving by having a better understanding of their spatial skills. "The use of art appears to be ideally suited to teaching the visual and spatial skills that underpin students' mathematical success, especially in a particular pictorial repertoire-that of visual diagrams and schematic representations" (Edens & Potter, 2007, p 284). There are two different types of drawings a student can create: schematic or non-schematic. Edens and Potter (2007) state that schematic drawings are pictorial selection that depicts proportional thinking and evidence of use of the drawing as problem solving tool and that non-schematic have no proportional details included in the drawing (p 7).

"Today, most math educators view problem solving as doing mathematics, a powerful vehicle for building understanding of mathematics concepts" (Hyde, 2007, p 45). It is imperative that educators remain open to utilizing different techniques and concepts to ensure that their students learn how to fully comprehend solving mathematical word problems. "Story problems pose difficulties for many students because of the complexity of the solution process" (Griffin & Jitendra, 2009, p 187). The importance of this skill is something that will be with individuals throughout most of their educational careers.

CHAPTER III

Methodology

Action research is any systematic inquiry conducted by teacher researchers, principals, school counselors, or other stakeholders in the teaching/learning environment to gather information about how their particular schools operate, how they teach, and how well their students learn (Mills, 2007, p.5). The research chosen by the researcher can be something that interests the researcher or a problem in the classroom. According to Mills (2007), the four-step process that is used for an action research project is: identifying an area of focus, collecting data, analyzing and interpreting data, and devolving an action plan. Triangulation is used in action research from at least three sources (for example; questionnaires, student work, and field notes). The researcher then analyzes all the data collected throughout the research and makes conclusions about the action research and develops a plan to implement. Action research often leads to a new area of focus. Essentially action research is supposed to benefit the students and the teachers.

Context of Study

My action research has taken place at Richard Stockton Elementary School in Cherry Hill School District. The school was named after Richard Stockton of the fifty-six signers of the Declaration of Independence. It is in a district where they have twelve elementary schools, three middle schools, and two high schools. Cherry Hill is located in Southern New Jersey in Camden County. The school's population that I am doing my

research is, 80% Caucasian, 4% African American, 14 % Asian, and 2% Hispanic (Public School Review, 2003-2009). It is the twelfth-largest school district in the state of New Jersey and one of the largest suburban districts. Stockton Elementary School houses kindergarten through fifth grade. There are a total of four hundred and thirty-two students that attend Stockton. Only 1% of the students are eligible for free lunch and 2% eligible for reduced lunch (Public School Review, 2003-2009). Cherry Hill is middle to high socio-economic status community.

In my fourth grade classroom there are nineteen students in the classroom all showing different strengthens academically and varied interests. There are ten boys and nine girls. The make-up of the classroom is eighteen students that are Caucasian and one African American. English is the dominant first language spoken at home. However there is one girl who speaks Spanish and a new student who is from Israel who speaks Hebrew. The classroom is arranged in tables of four and they change their seats every marking period. Four out of the nineteen students' parents are divorced and split their time with them. Six of the students are in a talented and gifted program, which they get pulled out once a week for an hour and half. The majority of the class performs on grade-level, but struggles in mathematics.

I chose to focus on five of my students in the classroom, three boys and two girls. I picked these kids by their varied level of problem solving skills. Throughout my time at Stockton Elementary one of my five students received A's on all of your math assignments and tests. Three of the five were on level and ranged from a C to B student. The fifth student struggles in math and receives lower than a C in math. I decided to look at a wide range of understanding to see what happened will the steps were applied to their

everyday math. All of the students were willing to participate in my study and were a huge help in my research.

Data Sources

Throughout my research I have used three different data sources; questionnaires, work samples, and journals. To gain some insight on how my students felt about problem solving I created a questionnaire that I would give to them before starting any of my research. The questionnaire was given to everyone in the class. The questionnaire was beneficial to the research because it guided me with my study to see where the students struggled and where they need help to improve on the problem solving skills.

Following the questionnaire I collected multiple work samples that varied from different days. I looked at assessments they had taken previous to any introduction to problem solving and after weeks of work. I was able to compare the two assessments to see if there was any improvement with the steps and strategies introduced. Other work samples collected were the many word problem worksheets they completed in class individually. Collecting the many work samples helped me understand how my research has affected their understanding of problem solving. The table below, is the comparison of the students' grades from before any introduction to problem solving to after weeks of work.

Table 1: Test Scores
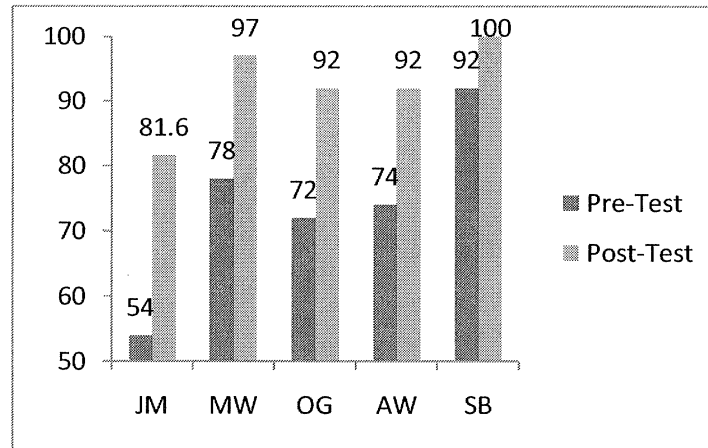
During my research I kept a journal of observations I was able to write down while the students were working on various assignments given. In this journal I wrote down little comments I heard from the students and/or questions they had when given the worksheets daily. Keeping a journal was very helpful to refer back to when analyzing my data, because I was able to remember the exact moment with the notes written down. Giving out a questionnaire, keeping a journal, and collecting work samples throughout my study has helped tremendously to make my research valid. Being organized and knowing what I had done in my research kept it going smoothly.

Trustworthiness

To ensure that this action research project is valid, I used Guba's Criteria of Qualitative Research (1981, as cited in Mills, 2007). According to Guba, there are four characteristics that must be met to insure trustworthiness of an action research project; credibility, transferability, dependability, and conformability.

Credibility refers to the researcher's ability to deal with the complexities or patterns in a study that are not easily explained. To guarantee that my research met all the characteristics of being credible, I used triangulation. My data collection included

observations from myself and cooperating teacher, student artifacts (including class work and assessments), and students surveys.

Transferability refers to the researcher being able to collect data that is specific to the particular topic of study. In other words this means being very descriptive of the setting of the community, school, and classroom so if needed someone could repeat the exact research. To ensure that this characteristic of validity is in my action research I collected all the data about the school and community. I was also very detailed about how the process was implemented in the classroom.

Dependability refers to the data collected for the research that is stable. To make sure the data you are collecting is dependable it is essential to use overlapping methods. By using two or more methods, if one method is weak it will be compensated by the strength of the other method used. I used this in my study, by giving the students different strategies to solve the same problem. Showing the students different way to complete the same problem will help ensured the learning of every student. I also went back to previous assessments given that had to deal with word problems and saw if they understood better how to solve it after learning the different strategies to problem solving.

Confirmability refers to being neutral when collecting the data and knowing that biases occur during research. I incorporated this characteristic in my research by being aware of any biases that come up during research and being open about them. I also practiced triangulation by gathering different sources of data throughout the research.

The reason for doing this action research is because I have a love for math. My concentration in school was math and science, and to this day I rather teach those two subjects. When I found out that my class struggled in math I jumped at the opportunity to

do this specific research. I had to watch myself when teaching math, because I can get wrapped up into it, and lose all track of time when we have a busy schedule to keep to it. My interest in this subject is a potential bias; because I spent more time concentrating on it than another teacher may because they do not have the same interest that I do.

CHAPTER IV

Findings, Analysis, and Interpretation

Findings

The implementation of the step-by-step approach to solving word problems I found three major findings. One of the first findings I noticed was the students were not consistent with labeling the answers they were giving. The second finding in my research was the students had a hard time answering what the problem was really asking them to solve. The third finding was that the students did not follow the steps introduced if the questions were not set up for them.

As I looked through their questionnaires I noticed that three of the students feel alright answering word problems, while the other two are nervous when they see word problems because of not knowing how to solve it (see appendix F). One of the students who participated in the study wrote for an answer "I get nervous because explaining things is hard for me" (Student Survey, March 2009). Two of the students feel that the length scares them and think the longer the harder the problem. One of the students who says the length does not scare her, states "No, the length does not scare me because if you take the time to read it and to underline it come to a shorter length" (Student Survey, March 2009). The student here is referring to a lesson we did about underlining what you need to know to solve the problem because sometimes there is unnecessary information given to try to trick students.

One of the findings I saw throughout this research was that the students had a hard time answering what the problem was asking. The students were given a test right before I implemented my research, and one of the questions on the test was to write your own story problem for 453 divided by 8. A problem a student wrote was: "There were 453 cookies. They had to put them in 8 boxes. How many boxes will there be?" (Unit Test, February 2009). Obviously this student was confused and was not able to write and solve the problem correctly. This was a pattern I saw with other students in this study as well. Another time after the strategy was implemented I saw a couple times students not answering what the question asked for. For example the problem was: "Hugh is building steps out of big cement blocks. The first step is three blocks wide and one block high. He has already built three steps and is ready to add another step. How many blocks will he use altogether to build the four steps?" (Student Worksheet, April 23, 2009). Two of the students answered how many blocks they would need to make the fourth step instead of total amount of blocks.

Another recurring pattern that I noticed while analyzing my data was that the students are very inconsistent in labeling their answer. One of the steps is to write your answer in a complete sentence and to make sure you always label. This is something that is not new to the students. They have been taught many years ago that when giving an answer you need to make sure you label it so they know what you are looking at. I could not find a pattern in when they remembered to label and when they did not.

After I taught the beginning lesson and went through the steps clearly and slowly I then began to give the students worksheets every day. The worksheets had the steps written out and prompted them with questions they had to answer before diving into the

problem. I noticed throughout the two weeks of giving the students the worksheets they always asked if they had to answer all the questions. They didn't like answering the questions before solving the problem they didn't see the point in it. For some situations I allowed them to underline what they knew instead of re-writing it because of time restrictions and there was a lot to rewrite. When I decided to take away the questions prompting them I noticed how they didn't follow the steps and they went back to their old ways to solving word problems.

Analysis

When analyzing my data I sorted everything out in chronological order according to the dates given. I then looked at the five students I chose to have in my study and compared them with one another. When I was looking through all the students' work I had a check list of items that I required for it to be acceptable. When students did not have something I wrote down it down in my journal. I did this for all the data so it was written out clearly so I could compare the students to each other and reoccurring themes stuck out for me.

I used a coding system which Mills (2007) defined it as the process of trying to find patterns and recurring themes in order to make meaning in data collected through the use of surveys, interviews, and questionnaires.

Interpretation

After reviewing my analysis of my data and findings, I feel I was successful to some degree to helping students understand how to solve word problems by giving them a step-by-step process. I believe that the students learned a process that some will remember and it will be beneficial to them as the progress in math. For the others I think

they just saw it as extra work they had to do before solving the problem. I do not feel they saw it as helping them dissect the problem so they understood what they problem was asking better. I feel if half of the class remember the steps and can apply it to their problem solving then the study was a success.

CHAPTER V

Conclusions

Summary

My study involved five out of nineteen students in my classroom. Three boys and two girls participated in this study all varying on academic level and strengths. I began this research focusing on improving students' attempt to solve word problems. I distributed a questionnaire so I was able to get to the root of the problem and have a better understanding of what challenges the students. From that point, I taught lessons on the process we would be using, and introduced them to strategies they would be able to use. I gave the students worksheets for about two weeks so they could practice the steps taught. The students were prompted with questions to follow and answer before solving the problem. Eventually I took away those questions and they had to solve the problem on their own.

New Understandings

During my action research project, I found that by introducing this process to students in a fourth grade classroom that they found it to be extra work and not a technique that would help them. It was very hard to get the students to answer every question that I had prompted for them on the worksheets. I have noticed during my time in this classroom that students are in a huge rush to complete assignments and move onto something new. They saw this as something that was holding them up from moving on to the next assignment assigned for them to complete. I think knowing how to solve a word

problem is very important, and I don't know if giving them the extra steps helped them in this situation. Though, I do feel that these steps are important and beneficial to use, but how to introduce them to the students needs to be changed where they can see that they are to help them out not give them more work.

Implications

After completing this action research project, I have realized how difficult it is for students to understand how to solve word problems. I noticed during this study that students were stressed out more with the steps and making sure they answered all the questions then focusing on what the problem was really asking them. If anything the students learned multiple strategies they can use when faced with a word problem and may have gained confidence in solving with all the practice they got.

Recommendations

For someone who would like to implement this study into his or her classroom, I would recommend stressing the importance of the steps given to the students. I did not explain to the students why I had them answering the question "What do you know?" and others. In retrospect, if I explained in more detail the reasoning behind the steps perhaps more students would have seen the merit in following them when they were not prompted with them. I would keep the same sequential order that I used because I think it is important that we did problems together to get them comfortable. Next they were prompted with the steps to follow, and finally I took them away. Modeling what you expect from your students is very important to keep the study on the page you want it.

New Directions and Questions

After going through all of my data and analyzing it I asked myself three questions; Did the step-by-step process that I implemented in my action research project, change the way my students comprehended the material? Did using different word problem strategies change the way my students' approached the problems? Did adding more questions in the steps confuse the students even more? Thinking back now I wonder if I was doing more harm than good. I would want to try to go back and implement this study a little different next time. For one, I wouldn't want to try to conduct this study while the students were preparing for the NJ ASK, which could have affected some of the students' ability to focus on something new. I would also like to see what would happen when this was introduced in the beginning of the year rather in April. A topic like this study can always be evaluated and adjusted to make it work best for that particular classroom.

REFERENCES

Adams, G., Cynthia C., Haria, P., Jitendra, A., & Kaduvettoor, A. (2007). A
comparison of single and multiple strategy instruction on third-grade student's
mathematical problem solving. *Journal of Educational Psychology,* 99(2), 115-127.

Damon, B., Monroe, E., & Panchyshyn, R. (2006). Helping children succeed
with word problems. *Mathematics in School,* 35(1). 4-5.

Edens, K., Potter, E. (2007). The relationship of drawing and mathematical problem
solving: Draw for math tasks. *Studies in Art Education: A Journal of Issues and
Research,* 48(3), 282-298.

Edens, K., Potter, E. (2008). How students "unpack" the structure of a word problem:
Graphic representations and problem solving. *School Science and Math,* 108(5).
184-196.

Forsten, C. (2004). The problem with word problems. *Principal,* 84(2), 20-23.

Garelick, B., Hoven, J. (2007). Singapore math: Simple or complex?. *Educational
Leadership,* 65(3), 28-31.

Griffin, C., Jitendra, A. (2009). Word problem-solving instruction in
inclusive third-grade mathematics classrooms. *The Journal of Educational
Research,* 102(3). 187-201.

Hyde, A. *(2007). Mathematics and cognition.* Educational Leadership, 65(3), 43-47.

Justice, J., Oliver-Hoyo, M. (2008). Promoting the use of higher-order cognitive skills in

qualitative problem solving. *Journal of College Science Teaching,* 37(5), 62-67.

Mills, G. (2007). Action research: A guide for the teacher researcher. Upper

Saddle River, NJ: Pearson Education Inc.

Unknown. (2009). Dictionary.com. Retrieved June 3, 2009, from www.dictionary.com

Unknown. (2006-2009). Richard Stockton Elementary School. Retrieved on May 28,

2009, from www.publicschoolreview.com

VanSciver, J. (2009). Working on word problems. *Education Digest,* 74(5), 26-28.

APPENDICES

APPENDIX A

Principal Consent Form

March 2, 2009

To Whom It May Concern:

I am aware that Lindsay Brooks will be researching the question: What happens when students learn a step-by-step approach to solving math word problems. The research will be taking place at Richard Stockton Elementary School. I give her permission to perform her Action Research Project in the fourth grade classroom, where she has been placed.

Sincerely,

Eloisa DeJesus-Woodruff
Principal

APPENDIX B

Parent Consent Form

Dear Parent/Guardian,

As you all know, I am currently seeking certification to be a teacher. One of my requirements for Rowan is that I must complete an Action Research Project. For this project, I had to decide on a topic that I'd like to learn more about. I'm interesting in seeing what happens when students learn a step-by-step approach to solving math word problems, and if this method helps them improve on writing their own math word problem. None of the information I collect, surveys I conduct, or interviews I do with the students will cause harm or affect their grades. I am asking for your permission for your child to be observed and included in my project. Your child's identity will be protected by using pseudonyms, made up names, and no personal information about the students will be shared.

If you have any questions or would like further information, please contact me at Brooks74@students.rowan.edu or send in a note with your child and I will respond as soon as possible.

Thank You,

Ms. Brooks

☐ I give permission for my child to participate in Ms. Brooks' project.
☐ I do NOT give permission for my child to participate in Ms. Brooks' project.

Parent/Guardian PRINTED Name   Parent/Guardian Signature

APPENDIX C

Student Questionnaire

Name:_____   Date:_____
Student Survey

1. How do you feel when you see word problems on a test? Why?

2. Does the length of the problem scare you? What is that length?

3. Is the vocabulary used in word problems unfamiliar to you? Give an example.

4. Is it easier for you to draw a picture to solve it? Why?

5. What is the hardest part to solving a word problem for you?

6. What do you like about word problems?

7. How many times do you need to go back and read the question?

8. Once you have figured out the answer, do you go back and check your work?

Name: _____   Date: 3·3/·09

Student Survey

1. How do you feel when you see word problems on a test? Why?

Word problems do not trouble me because
I do them in class, for HW, and many other thing

2. Does the length of the problem scare you? What is that length?

No, the length does not scare me because if you
take the time to read it and to underline it comes
to a shorter length.

3. Is the vocabulary used in word problems unfamiliar to you? Give an example?

Sometimes there is some vocab that is unfamiliar to
me, j__

4. Is it easier for you to draw a picture to solve it? Why?

No because I like to write a number sentence
or an equation.

5. What is the hardest part to solving a word problem for you?

The hardest part for me is explaining your
thinking. Its not super hard... I can still do

6. What do you like about word problems? it... but it takes a long ti

I like when your write a number sentence
or an equation.

7. How many times do you need to go back and read the question?

I would say 3-4 times just so I get the
right data and I understand it completly.

8. Once you have figured out the answer, do you go back and check your work?

Yes because you could have made a silly
mistake!!

Name: _____   Date: 3-31-09

Student Survey

1. How do you feel when you see word problems on a test? Why?

   I feel ok because sometimes
   I understand the question and sometimes I don't.

2. Does the length of the problem scare you? What is that length?

   no it doesn't scare me if its really
   long I just have to read it a couple times to understd

3. Is the vocabulary used in word problems unfamiliar to you? Give an example?

   no. I read the words around and
   try to figure out the word.

4. Is it easier for you to draw a picture to solve it? Why?

   yes, because than I can see
   it my mind.

5. What is the hardest part to solving a word problem for you?

   finding out what their
   asking me.

6. What do you like about word problems?

   the stories they come up with

7. How many times do you need to go back and read the question?

   like 3 or 4 times.

8. Once you have figured out the answer, do you go back and check your work?

   yes, if there are a lot
   steps I check to make sure I
   got all of them.

Name _____ Date: 3-31-09

Student Survey

1. How do you feel when you see word problems on a test? Why?

I get nervous because explaining things is hard for me.

2. Does the length of the problem scare you? What is that length?

Sometimes when the length of the problem is long.

3. Is the vocabulary used in word problems unfamiliar to you? Give an example?

No! I am familiar with most vocabulary in word problems.

4. Is it easier for you to draw a picture to solve it? Why?

It is easier for me to draw a picture, because I might get confused on my answer.

5. What is the hardest part to solving a word problem for you?

The hardest part of solving a word problem for me is coming up with a way to solve the problem.

6. What do you like about word problems?

I like you can use pictures, numbers or words to solve the problem

7. How many times do you need to go back and read the question?

I go back to read the question about 3,4or5 times.

8. Once you have figured out the answer, do you go back and check your work?

Sometimes if it is a tricky problem to see if I made a mistake.

APPENDIX D

Group Word Problems

Time
Roger watched a movie lasting 2hr. 25 min. Then he watched a documentary lasting 103 min. If he finished watching both at 5:15 PM, at what time did he start?

Mean
The mean score of five scores is 56. Four of the scores are 89, 40, 72, and 37. What is the missing score?

Tree Diagram
How many one-flavor, one-topping combinations are possible?

Flavors	Toppings
Vanilla	Raisins
Strawberry	Peanuts
Banana	Granola
Chocolate	Almonds
	Sprinkles

Probability
Using the words: **Kolodzey & Brooks**

What is the probability for picking a vowel?
What is the probability for picking a capital letter?
What is the probability for picking a lower case letter?
What is the probability for picking a "c"?

I should see a fraction and whether it is certain, likely, unlikely, or impossible.

Line Plot
Math Facts Complete in One Minute

55	60	55	35	40	50
55	35	60	50	35	45
45	60	50	65	40	60
50	50	40	50	40	55

Make a line plot using the data. Write a statement about the line plot. What are the mode, range, and median.

APPENDIX E

Data Table

Theme	Data

Labeling (L)	PRE – 2 of the students labeled their answers on the test.
	WS- 4/14/09 – All the students used a chart to answer the question
	WS- 4/15/09 – No labels used
	WS- 4/20/09 – 2 students did not label and 3 students did
	WS- 4/21/09 – None of the student's labeled their answers
	WS- 4/22/09 – All the students labeled their answers
	WS- 4/23/09 – All the students labeled their answers
	WS- 4/27/09 – 1 student labeled their answer others used charts
	WS- 4/28/09 – 1 student labeled their answer
	GW- 4/29/09 –Student A used labels for all five problems
	        Student B used labels for half of the problems
	        Student C used labels for 2 out of the 5 problems
	        Student D used labels for 1 out of the 5 problems
	        Student E used labels for 1 out of the 5 problems
	POST – Only 1 student labeled her answers on the test and the others got points off for no labels

Following the Steps (FS)	WS- 4/14/09 – 4 out of the 5 students answered all the questions pertaining to the steps introduced WS- 4/15/09 – Only 1 students followed all the steps WS- 4/20/09 – 3 out of 5 completed all steps WS- 4/21/09 – None of the students completed all steps WS- 4/22/09 – 4 out of 5 completed all steps WS- 4/23/09 – 4 out of 5 completed all steps WS- 4/27/09 – 3 out of 5 completed all steps WS- 4/28/09 – 3 out of 5 completed all steps GS- 4/29/09 – None of the students followed the steps when they were not prompted for them.
Answering What the Problem is Asking (AWPA)	PRE- 2 out of the 5 answered the word problem correctly WS- 4/14/09 – 1 out of 5 student answered correctly WS- 4/15/09 – 2 out of 5 students answered correctly WS- 4/20/09 – 3 out of 5 students answered correctly WS- 4/21/09 – 3 out of 5 students answered correctly WS- 4/22/09 – 4 out 5 students answered correctly WS- 4/23/09 – All 5 students answered it correctly WS- 4/27/09 – All 5 students answered it correctly WS- 4/28/09 – 4 out of the 5 answered the problem what it was asking. 3 got the correct answer POST- All students got the questions correct

Data key: WS=work sample GW=group work PRE= test before steps introduced POST= test after steps introduced

35

APPENDIX F

Data Table on Student Survey

Question	Response
Number 1	2 students feel nervous with word problems 2 students feel just ok with word problems 1 student feels confident
Number 2	4 students do not care about the length of the word problem 1 student thinks the longer the word problem the harder
Number 3	2 students find vocabulary hard in word problems 2 students find vocabulary is sometimes difficult 1 student did not answer this question
Number 4	3 students like drawing a picture to solve the problem 1 student sometimes solves problems using a picture 1 student rather use an equation to figure out the problem
Number 5	1 student finds it hard to explain her thinking 2 students find it hard to figure out what they are asking 1 student says answering the problem 1 student didn't answer
Number 6	4 of the students found something they like 1 student doesn't like anything
Number 7	All students agree you should check over your work 3-4 times
Number 8	All students say they check their work when they are finished

APPENDIX G

Pre-Test Samples

MW 23/25   2nd

9. a.) Write a story problem for **459 ÷ 8**.

4/5 pts

Sean has 459 wrestling trading cards and 8 binders. One binder holds 57 cards. If he can fill the binders will there be leftovers? If there are leftovers how many will there be.

I think you had solved the problem before you wrote the story. You should not include that the binder holds 57 cards. It would be better to say: How many cards can be equally divided into 8 binders?

b.) Solve your story problem. Show your work so that someone looking at it can understand how you solved your problem.

$$8)\overline{459} \quad 57 \ R3$$
$$-40\downarrow$$
$$59$$
$$-56$$
$$3$$

I divided 459 by 8 and got 57 remainder 3. All the binders will be filled. There will be 3 leftovers.

37

SB 23/25

9.

a.) Write a story problem for **453 ÷ 8**.

I have 453 stamps in my collection.
I decided to give them to my 8
younger cousins. How many stamps
will each of my cousins get?

b.) Solve your story problem. Show your work so that someone looking at it can understand how you solved your problem.

I used standard division. I know that
8 cant go into 4 so I add on
the 5. 8 goes into 45 5 times.
I subtract 40, because 8x5 is 40
and that is the closest I can
get to 45 without going over, and
got 5. Then I bring down the 3.
8 goes into 53 6 times. I subtract
48 from 53, because 48 is the
closest I can get to 53 without
going over. I end up with 5. The answer
is 56 R5.

5/5

9.

a.) Write a story problem for **453 ÷ 8**.

$\frac{3}{5}$ 4 pts

There were 453 cookies they had to put them in 8 boxes. how many boxes will there be?

You told me there were 8 boxes. What question did you really want to ask?

b.) Solve your story problem. Show your work so that someone looking at it can understand how you solved your problem.

I did long division and I got 56^{R5} I did long division because it made sense and I thought that was the only way.

56R5
8)453
12

R$\frac{3}{8}$

3/5

9.

a.) Write a story problem for **459 ÷ 8**.

4
5 pts

There were 459 paper clips the students had collected over the years They want to put them into equal groups of 8 How many equal groups of 8 will there be?

b.) Solve your story problem. Show your work so that someone looking at it can understand how you solved your problem.

```
       5Y   R3
  8 ⟌459
      40
       5.9
      56
       3
```

there will be 5Y groups of Paper clips. What about the remainder?

8, 16, 24, 32, ⟨40⟩ 48, ⟨56⟩ 64

13½/15

a.) Write a story problem for **453 ÷ 8**.

4 pts

There are 453 lolypops. I put them in 8 groups. How meny groups of 8 are there?

b.) Solve your story problem. Show your work so that someone looking at it can understand how you solved your problem.

45 groups with a remainder of 5 (85)
8÷45=5 so I put it over the 5 and then
I did 8x5=40, then I did 45+40=85
After that I compaired and 85 in more
then 8 so I cant keep going.

16
16
8
40

8)45
40
85

APPENDIX H

Post-Test Samples

OG $\frac{17\frac{1}{2}}{19}$

Short Answer

11. Little League, founded in 1937, is a worldwide baseball organization for youngsters.
   - If Andres has 5, 6, 1 and 4 hits in his last four games, what is his mean number of hits each game?

Show/explain all work using numbers, pictures, and/or words.

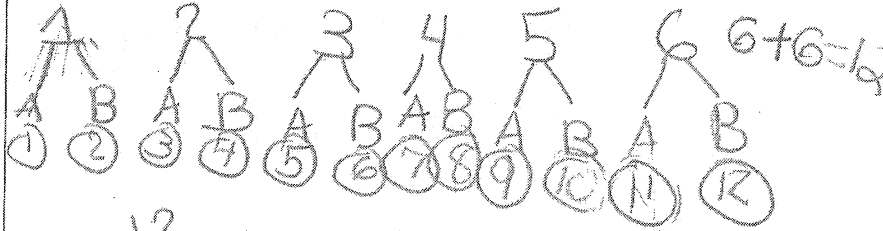Answer _____4_____ (mean)

12. **Showing Outcomes**
   - **Make a tree diagram** to show all the possible outcomes for spinning the spinner and then tossing the number cube.
   - What is the total number of outcomes?

Cube has sides 1 to 6.

Show all work using numbers, pictures, and/or words.

6+6=12

Answer _____12_____ outcomes

Short Answer

11. Little League, founded in 1937, is a worldwide baseball organization for youngsters.
    - If Andres has 5, 6, 1 and 4 hits in his last four games, what is his mean number of hits each game?

Show/explain all work using numbers, pictures, and/or words.

# of Hits Andres did in the last 4 games.

$$+\frac{6}{56}$$

$$\frac{11}{+4}$$

$$15$$

$$\frac{+1}{16}$$

$$4\overline{)16}$$

Answer 4 hits *(mean)*

12. **Showing Outcomes**

   - **Make a tree diagram** to show all the possible outcomes for spinning the spinner and then tossing the number cube.

   - What is the total number of outcomes?

   Cube has sides 1 to 6.

Show all work using numbers, pictures, and/or words.

A
1 2 3 4 5 6

6+6=12

B
1 2 3 4 5 6

Answer 12 outcomes

Short Answer

11. Little League, founded in 1937, is a worldwide baseball organization for youngsters.
    - If Andres has 5, 6, 1 and 4 hits in his last four games, what is his mean number of hits each game?

Show/explain all work using numbers, pictures, and/or words.

$$\frac{\cancel{4}4}{16}$$

$$\begin{array}{c} 5 \\ 6 \\ 1 \\ 4 \\ \hline 16 \end{array} \qquad 4\overline{\smash{)}16}\,^4$$

Good!

Answer ___4___ (mean)

12. **Showing Outcomes**
    - Make a tree diagram to show all the possible outcomes for spinning the spinner and then tossing the number cube.
    - What is the total number of outcomes?

A | B (spinner) | 3 (cube)   Cube has sides 1 to 6.

Show all work using numbers, pictures, and/or words.

A — 6, 5, 1, 2, 3, 4

B — 6, 2, 3, 4, 5

Answer ___12___ outcomes

Short Answer

11. Little League, founded in 1937, is a worldwide baseball organization for youngsters.
    - If Andres has 5, 6, 1 and 4 hits in his last four games, what is his mean number of hits each game?

Show/explain all work using numbers, pictures, and/or words.
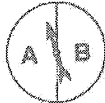
$$\begin{array}{r} 5 \\ +6 \\ +1 \\ \hline 3\overline{)12} \end{array}$$
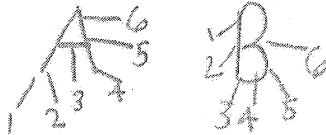
Answer _____4_____ *(mean)*

12. **Showing Outcomes**
    - **Make a tree diagram** to show all the possible outcomes for spinning the spinner and then tossing the number cube.
    - What is the total number of outcomes?

    A | B spinner   Cube has sides 1 to 6.

Show all work using numbers, pictures, and/or words.

Answer __12__ outcomes

Short Answer

11. Little League, founded in 1937, is a worldwide baseball organization for youngsters.
    - If Andres has 5, 6, 1 and 4 hits in his last four games, what is his mean number of hits each game?

Show/explain all work using numbers, pictures, and/or words.

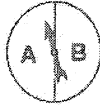$$\begin{array}{r} 4 \\ 4\overline{)16} \\ -16 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 5 \\ 6 \\ 1 \\ +4 \\ \hline 16 \end{array}$$
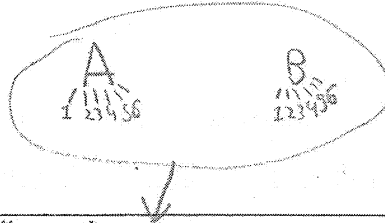
Answer ___4 ; $\cancel{\text{hits}}$___ (mean) 6

12. **Showing Outcomes**
    - Make a tree diagram to show all the possible outcomes for spinning the spinner and then tossing the number cube.
    - What is the total number of outcomes?

A | B   Cube has sides 1 to 6.

Show all work using numbers, pictures, and/or words.

A
1 2 3 4 5 6

B
1 2 3 4 5 6

Answer ___12___ outcomes

Work Sample 1

Name:_____   Date:_____

On Saturday Afternoon Mike and his friends are trying to decide what to do. They are going to bike, walk, or go by skateboard to the park. They can go swimming, play catch, or fly a kite at the park. Then they will go get ice cream, popcorn, or soda. What are the different plans Mike and his friends can make for Saturday afternoon?

1. UNDERSTAND
   What do you need to find out?

   What do you know?

2. PLAN
   How will you solve it? What strategy is best to solve this problem?

3. SOLVE

4. LOOK BACK AND CHECK
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

Name: _____   Date: 4.30.09

On Saturday afternoon Mike and his friends are trying to decide what to do. They are going to bike, walk, or go by skateboard to the park. They can go swimming, play catch, or fly a kite at the park. Then they will go get ice cream, popcorn, or soda. What are all the different plans Mike and his friends can make for Saturday afternoon?

1. **UNDERSTAND**
   What do you need to find out?

   what are All the diffrent planes mike and his friends can make for saturday afternoon?

   What do you know?

   they can bike,walk ,or go by skatbord to the park.
   they can go swimming,play catch,or fly a kite at the park.
   they can get icecream,popcorn,or soda

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

   macking a tree diogram

3. **SOLVE**

   9 diffrent plans

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked? ✓

   Did you answer all parts of the problem? ✓

   Is your work correct? ✓

Name: _____ Date: 4-20-09

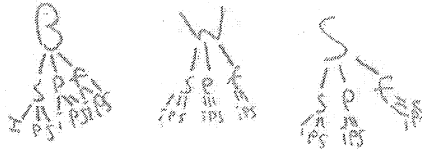On Saturday afternoon Mike and his friends are trying to decide what to do. They are going to bike, walk, or go by skateboard to the park. They can go swimming, play catch, or fly a kite at the park. Then they will go get ice cream, popcorn, or soda. What are all the different plans Mike and his friends can make for Saturday afternoon?

1. **UNDERSTAND**
   What do you need to find out?

   What are the different plans that Mike and his friends can do.

   What do you know?

   I know he can bike, walk, skateboard, swim, play catch or fly a kite at the park and they could get irecream, popcorn or soda.

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

   I will use a tree diagram. I think this is the best strategy to solve this problem.
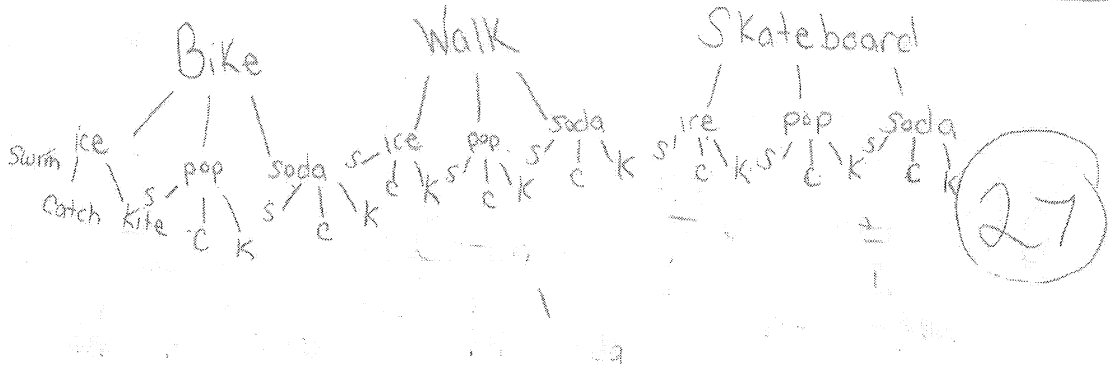
3. **SOLVE**

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?

   Yes I did.

   Did you answer all parts of the problem?

   Yes I did.

   Is your work correct?

   I have checked it and yes it is correct.

APPENDIX J

Work Sample 2

Name:_____   Date:_____

Danielle was the 100th runner across the finish line. Lots of runners finished after Danielle. Here are some clues for the number of runners who finished the race.

          --It is more than 280
          --It is less than 316
          --If you count by 4's you say its name
          --It can be divided evenly by 7

1. UNDERSTAND
   What do you need to find out?

   What do you know?

2. PLAN
   How will you solve it? What strategy is best to solve this problem?

3. SOLVE

4. LOOK BACK AND CHECK
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

Name: _____   Date: 4/21/09

Danielle was the 100th runner across the finish line. Lots of runners finished after Danielle. Here are some clues for the number of runners who finished the race.

√ • It is more than 280
   • It is less than 316
   • If you count by 4's you say its name
   • It can be divided evenly by 7

1. **UNDERSTAND**
   What do you need to find out?
   for the number of runners who finished the race
   What do you know?
   It can be divided evenly by 7
   If you count by 4's you say it's nam

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?
   I will count on

3. **SOLVE** ~~280~~ ~~284~~ ~~288~~ ~~292~~ ~~296~~ ~~300~~ ~~304~~ (308)
   ~~312~~ ~~316~~ ~~320~~ ~~324~~ ~~328~~

   (308)

   $$\begin{array}{r} 40 \\ 7\overline{)280} \\ 28 \\ \hline 0 \end{array}$$

   $$\begin{array}{r} 42\,R6 \\ 7\overline{)300} \\ 28 \\ \hline 20 \\ 14 \\ \hline 6 \end{array}$$

   $$\begin{array}{r} 44 \\ 7\overline{)308} \\ 28 \\ \hline 28 \\ 28 \\ \hline 0 \end{array}$$

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

Name: _____   Date: 4-21-09

Danielle was the 100th runner across the finish line. Lots of runners finished after Danielle. Here are some clues for the number of runners who finished the race.

- It is more than 280 ✓
- It is less than 316 ✓
- If you count by 4's you say its name
- It can be divided evenly by 7

1. **UNDERSTAND**
   What do you need to find out?

   How many people finished the race

   What do you know?

   Danielle was the 100th one to finish

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

   Using the clues, with a number line

3. **SOLVE**

   ←280 —————————————— 316→

   36 numbers inbetween

   $$\begin{array}{r} 2\,14 \\ \cancel{3}\,\cancel{1}6 \\ -280 \\ \hline 36 \end{array}$$

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?
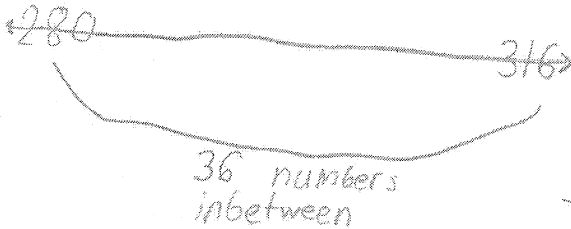
   281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316

   Did you answer all parts of the problem?

   Is your work correct?

APPENDIX K

Work Sample 3

Name:_____   Date:_____

The kitten climbed its first tree and got stuck on the top branch. First it went up the trunk of the tree and on up to the 6th branch. A big squirrel scared the kitten and it climbed down 3 branches. A bird flew at the kitten and scared it again. Now it climbed up 10 branches. The kitten climbed back down 2 branches and then went up 4 branches to the very top of the tree. How many branches were in the tree?

1. UNDERSTAND
   What do you need to find out?

   What do you know?

2. PLAN
   How will you solve it? What strategy is best to solve this problem?

3. SOLVE

4. LOOK BACK AND CHECK
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

The kitten climbed its first tree and got stuck on the top branch. First it went up the trunk of the tree and on up to the 6th branch. A big squirrel scared the kitten and it climbed down 3 branches. A bird flew at the kitten and scared it again. Now it climbed up 10 branches. The kitten climbed back down 2 branches and then went up 4 branches to the very top of the tree. How many branches were in the tree?

1. **UNDERSTAND**
   What do you need to find out?

   What do you know?

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

3. **SOLVE**

$$6 + 1 \overline{\smash{)}\ 3} \quad 4$$

$$\begin{array}{r} 10 \\ -\ 4 \\ \hline 6 \end{array} \quad \begin{array}{r} 6 \\ -\ 2 \\ \hline 4 \end{array} \quad \begin{array}{r} 4 \\ +\ 4 \\ \hline 8 \end{array}$$

$$\begin{array}{r} 4 \\ 2 \\ 10 \\ +\ 3 \\ \hline 6 \end{array}$$

$$\boxed{26}$$

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

there are 26 branches on the trees

The kitten climbed its first tree and got stuck on the top branch. First it went up the trunk of the tree and on up to the 6th branch. A big squirrel scared the kitten and it climbed down 3 branches. A bird flew at the kitten and scared it again. Now it climbed up 10 branches. The kitten climbed back down 2 branches and then went up 4 branches to the very top of the tree. How many branches were in the tree?

1. **UNDERSTAND**
   What do you need to find out?

   How many branches were there

   What do you know?

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

   to start at the top add and subtract

3. **SOLVE**

   $$
   \begin{array}{r}
   6 \\
   3 \\
   + 10 \\
   \hline
   13 \\
   - 2 \\
   \hline
   11 \\
   + 4 \\
   \hline
   15 \\
   \end{array}
   $$

   (15 branches)

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?

   yes

   Did you answer all parts of the problem?

   yes

   Is your work correct?

   I checked it and I'm pretty sure.

APPENDIX L

Work Sample 4

Name:_____   Date:_____

Hugh is building steps out of big cement blocks. The first step is three blocks wide and one block high. He has already built three steps and is ready to add another step. How many blocks will he use altogether to build the four steps?

1. UNDERSTAND
   What do you need to find out?

   What do you know?

2. PLAN
   How will you solve it? What strategy is best to solve this problem?

3. SOLVE

4. LOOK BACK AND CHECK
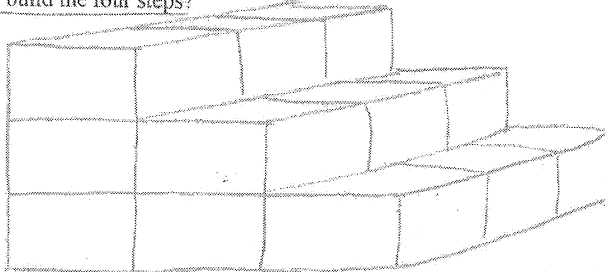   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

Name: _____   Date: 4/23/09

Hugh is building steps out of big cement blocks. The first step is three blocks wide and one block high. He has already built three steps and is ready to add another step. How many blocks will he use altogether to build the four steps?

9 all togeth

1. **UNDERSTAND**
   What do you need to find out?
   How much would be there if there was a fourth step
   What do you know?
   How many blocks would be there if there was a fourth block

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?
   I will use a pattern

   2
   12
   9
   6
   3
   —
   (30)
   block all togeth

3. **SOLVE**
   3 blocks on first step
   6 blocks on second step
   9 blocks on third
   12 blocks on fourth step

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?
   yes
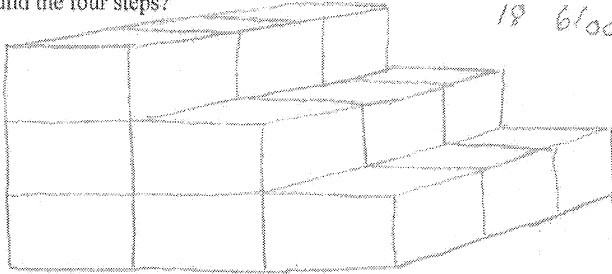   Did you answer all parts of the problem?
   yes
   Is your work correct?
   yes

Name _____   Date: 4-23-09

Hugh is building steps out of big cement blocks. The first step is three blocks wide and one block high. He has already built three steps and is ready to add another step. How many blocks will he use altogether to build the four steps?

18 blocks

1 = 3
2 = 6
3 = 9
4 = 12

1. **UNDERSTAND**
   What do you need to find out?

   How much more blocks do you need for the
   first step

   What do you know?

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

   There are 18 blocks with three steps

3. **SOLVE**

   For the fourth step you would need
   12 blocks. You would have 30 steps
   in all.

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

APPENDIX M

Work Sample 5

Name:_____   Date:_____

Iris, Maxine, Rudolfo, and Ralph were dreaming about competing in the Olympics in track, swimming, the high jump, and gymnastics. Iris is the fastest runner at school, and Ralph hates water. When Rudolfo goes to school, he jumps over the gate instead of going through it. Which Olympic sport do you think each of the kids would choose?

1. UNDERSTAND
   What do you need to find out?

   What do you know?

2. PLAN
   How will you solve it? What strategy is best to solve this problem?

3. SOLVE

4. LOOK BACK AND CHECK
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

Iris, Maxine, Rudolfo, And Ralph were dreaming about competing in the Olympics in track, swimming, the high jump, and gymnastics. Iris is the fastest runner at school, and Ralph hates water. When Rudolfo goes to school, he jumps over the gate instead of going through it. Which Olympic sport do you think each of the kids would choose?

1. **UNDERSTAND**
   What do you need to find out?

   what olympic sport the kids would choose.

   What do you know?

   What the kids like.

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

3. **SOLVE**

   Rudolfo would choose high jump.
   Iris would choose track.
   Maxine would choose swimming.
   Ralph would choose gymnastics.

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

Name: ⬛⬛⬛   Date: 4.27.09

Iris, Maxine, Rudolfo, And Ralph were dreaming about competing in the Olympics in track, swimming, the high jump, and gymnastics. Iris is the fastest runner at school, and Ralph hates water. When Rudolfo goes to school, he jumps over the gate instead of going through it. Which Olympic sport do you think each of the kids would choose?

1. **UNDERSTAND**
   What do you need to find out?

   Which Olympic sport do you think each of the kids would choose.

   What do you know?

   Iris is fast, Ralph hates water, Rodolfo jumps over the gate

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

   I will make a graph. Since I do this in TAG, I think it is the best way

3. **SOLVE**
   to solve this problem.

	swimming	track	high jump	gymnastics
Iris	X	O	X	X
Maxine	O	X	X	X
Rudolfo	X	X	O	X
Ralph	X	X	X	O

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?

   Yes I did.

   Did you answer all parts of the problem?

   Yes I did

   Is your work correct?

   Yes my work is correct.

Work Sample 6

Name:_____   Date:_____

Amy was soaking her poor sore feet! Together Amy and Marcus had walked a total of 10½ miles in the Wilbur School Walk-a-Thon. Amy walked twice as far as Marcus and she had blisters to prove it. How many miles did Amy and Marcus each walk?

1. UNDERSTAND
   What do you need to find out?

   What do you know?

2. PLAN
   How will you solve it? What strategy is best to solve this problem?

3. SOLVE

4. LOOK BACK AND CHECK
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?

Name: _____   Date: 4-26-09

Amy was soaking her poor sore feet! Together Amy and Marcus had walked a total of 10 ½ miles in the Wilbur School Walk-a-thon. Amy walked twice as far as Marcus and she had blisters to prove it. How many miles did Amy and Marcus each walk?

1. **UNDERSTAND**
   What do you need to find out?

   How many miles did Amy and Marcus each walks?

   What do you know?

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

3. **SOLVE**

   Total - $10\frac{1}{2}$

   Amy - $7\frac{1}{2}$ miles

   Marcus - $3\frac{1}{2}$ miles

   9 miles

   $\begin{array}{r} 9 \\ +1 \\ \hline 10 \end{array}$

   $\begin{array}{r} 6\frac{1}{2} \\ +3\frac{1}{2} \end{array}$ $1 + 3\frac{1}{2}$

   $3\frac{1}{2}$

   $\begin{array}{r} 1 + 3\frac{1}{2} \\ \hline 7\frac{1}{2} \end{array}$

   $7 + 3\frac{1}{2} = 10\frac{1}{2}$

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Amy = 7

   Is your work correct?

   Marcus = $3\frac{1}{2}$

Amy was soaking her poor sore feet! Together Amy and Marcus had walked a total of 10 ½ miles in the Wilbur School Walk-a-thon. Amy walked twice as far as Marcus and she had blisters to prove it. How many miles did Amy and Marcus each walk?

1. **UNDERSTAND**
   What do you need to find out?

   How many miles did Amy and Marcus each walk.

   What do you know?

   Amy and Marcus walked 10 and a half miles and Amy walked twice as far.

2. **PLAN**
   How will you solve it? What strategy is best to solve this problem?

3. **SOLVE**

   $3\frac{3}{4} \times 2 = 7\frac{1}{2}$

   Amy = $7\frac{1}{2}$

   Marcus = $3\frac{3}{4}$

4. **LOOK BACK AND CHECK**
   Did you solve the problem that was asked?

   Did you answer all parts of the problem?

   Is your work correct?