

Literacy Case Study

By

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Strategy Selection Rationale

Many people, students and some teachers alike, do not view reading comprehension as an essential skill in the mathematics classroom. However, with the new state graduation requirements and changes in the methods for assessing adequate yearly progress, reading comprehension has become the key to being successful. Students are no longer assessed strictly on their ability to use mathematical algorithms. Now students are required to read word problems, determine what the problem is asking them to find, decide which information is important and which information is extraneous, select the best method for solving the problem and, finally, complete the computation. With poor reading skills, it becomes increasingly difficult to successfully answer this type of question. The typical response by most students to the “dreaded word problem” is to either skim the problem to hopefully gain enough information to come up with an attempt at the problem or to skip the problem entirely because they do not know how to get started. (Standard III)

One strategy for improving reading comprehension is the use of the graphic organizer. According to Barbara Ehren in *Looking for Evidence-Based Practice in Reading Comprehension Instruction*, “Such devices are designed to help students develop background knowledge and to grasp relationships among concepts. Their value is to make concepts more concrete, depict relationships, serve as an aid to memory, and use context to enhance learning.” (Ehren, 2005, p.313.) I have selected two different graphic organizers to compare during this case study (Standard VI.)

Description of Graphic Organizers

The first graphic organizer is a modified KWL. In a typical KWL, students fill in the K – what they know, and the W – what they want to find out before they do the reading. The L – what they learned, is usually filled in after the reading is completed. I am using a KNWSS (see pg. 16) which is a KWL modified to better suit the math word problem. The K – what facts does the student know from the information in the problem, is filled in after the problem has been read the first time. The N – which information is not needed, is also filled in at that time. The W – what does the problem ask the student to find, is filled in after the problem is read a second time. The first S – what strategy/operation/tools is the student going to use to solve the problem, is filled in after reviewing all of the other information in the graphic organizer. The second S – solve the problem and does my answer make sense, is where the student solves the problem and analyzes their answer to make sure it makes sense in the context of the problem.

The second graphic organizer is one that I designed myself based on the designs of two other organizers that I found online. (Standard V) This organizer divides the page into four boxes in the corners of the page with a diamond in the middle (see pg. 17). First students fill out the top left corner box with the information that they know from the problem. Then they fill out the diamond in the middle with what the problem is asking them to find. Third they fill in the upper right hand corner of the page with a brainstormed list of ways to solve the problem. Next, they fill in the lower left hand corner with their work to solve the problem and an explanation of whether their answer makes sense in the context of the problem. Finally, students fill in the lower right hand

corner with information they need to include in their explanation of how to solve the problem.

Lesson Objectives

The main objective of the lesson is to teach students how to critically analyze math word problems by using a graphic organizer to improve their comprehension and their overall performance on these types of problems. A second objective is to give students a strategy for working with word problems that will make them more likely to engage in solving this type of problem. Having a strategy that students can use to solve any type of word problem will help them to overcome feeling intimidated and not knowing how to get started.

Lesson Description

During this case study, I taught two different students the same lesson using the same lesson plan (see pg. 18-19). Both sessions with the students followed the same format with the only difference being which graphic organizer was used. Each lesson started with a questionnaire (see pg. 20) regarding how students normally approach word problems, what they like about them, what they dislike about them and what types of strategies they have been taught in the past. Once the questionnaire was completed, the student and I discussed the results so I could get a better idea as to the students overall attitude toward solving word problems.

After the questionnaire, each student solved three word problems using their normal approach to this type of problem (see pg. 21 for the pre-instruction problems given to each student). The problems were selected based on the grade level content expectations for each students grade level (Standard II). Students were asked to show

all of their work and to be prepared to discuss their approach to solving these problems. Once the problems were completed, we discussed each problem and what specific difficulties the student had solving this particular problem.

After the pre-instruction problems were complete, I described to the students the objective of the lesson. I also provided them a description of what a graphic organizer is and how they can be useful for organizing information and helpful in planning a strategy for solving the problems. We discussed whether the students had used a graphic organizer before and, if they had, if it had been helpful for understanding the concepts being taught.

With each student, I modeled use of the graphic organizer by solving the first of the three pre-assessment problems. By doing this, the students were already familiar with the context of the problem and were able to focus more on the process of using the organizer instead of being concerned about the math. I started by reading the problem aloud to the student and asking them if there were any words in the problem that they did not understand. I explained to them that it is essential that they read the entire problem through once before they begin to fill in the graphic organizer. After the first reading, I filled in the first section of the organizer and explained to the students what type of information would go in this section. I read the problem aloud again and proceeded to fill in the second section of the organizer, again explaining what type of information would go in that section. Once I had organized all of the information that was needed from the problem, I focused on the other sections of the organizer that require student to use the information to solve the problem and justify their answers.

During the entire modeling process students were encouraged to ask questions if they did not understand any portion of what was being done.

After I modeled using the graphic organizer, the students used the other two pre-instruction problems to fill in their own graphic organizers with support when necessary. During this portion of the lesson, the students were able to ask specific questions and I was able to make suggestions to help the students solidify their understanding of how to use the organizer. Once the students completed the guided participation portion, I asked them to complete three post-instruction problems using the graphic organizer (see pg. 22 for the post-instruction problems used with each student).

At the end of the lesson, I summarized how to use the graphic organizer and discussed with the students how they felt about using the organizer. We talked about whether they thought it was helpful, if there were specific situations where they would find the organizer useful, and if there were any changes that they would make to make the organizer more helpful.

Description of Charlie

The first student that I taught was my 15 year old niece, Charlie. Charlie will be entering the 10th grade this fall and will be taking Algebra II as her math course. She is an excellent reader. She has enjoyed reading for pleasure since she was very young and continues to spend a significant amount of time reading. Reading has always been very easy for Charlie and she has consistently read above grade level since early elementary. Because Charlie is my niece and she attends the school where I teach, I am very familiar with her academic history. She has always been an excellent student and, in most cases, school has been very easy for her. It was also much easier to

design pre-instruction and post-instruction questions for this student because I am very familiar with the math content that this particular student has been taught.

Although Charlie is an excellent reader, she has struggled with solving word problems in the past. There have been several occasions during the past two years where she has asked me for help on her homework, and the problems that she needs help on have almost exclusively been word problems. According to the word problem questionnaire that she filled out for this lesson (see pg. 23), her normal approach to word problems is to “read it and if it looks hard, skip it.”

Analysis of Results with Charlie

I started the lesson with Charlie by reviewing her word problem questionnaire. Along with finding that she has a tendency to skip difficult word problems, I was also able to see that she struggles with the clarity of word problems and that she doesn't always know what to do with the information from the problem or what the problem is looking for. From this, I chose to use the diamond graphic organizer with her because it stresses what the problem is asking for by placing it at the center of the page.

On the whole, Charlie's pre-instruction problems showed that, not only is her usual approach to word problems unorganized, but also that she is likely to make a random guess at the problem if it appears to be difficult. During the first pre-instruction problem (see pg. 24), she started by making an improper assumption because she did not read the problem correctly. After re-reading the problem, she crossed it out and made another attempt. On her second attempt, she made five random guesses at solutions to the problem but did not appear to have any rhyme or reason to her guesses. I asked her during our discussion how she solved the problem and her

response was, “I guessed.” When I pushed her further to explain how she decided what to guess, she said, “I don’t know. I picked numbers until I got tired of it.” Once she was tired of it, she used her last answer and did not check to see if it was correct.

Her second pre-instruction problem (see pg. 26) was much more organized than the first. This problem used many more comparative verbal descriptions than the first problem. I used this particular problem to see how well she comprehended these numerical comparisons when they are presented in words instead of numbers and mathematical operations. Her strategy for solving this problem was also to make a guess; however, in this case, she had a logical explanation for the guess. She explained that, “I started with one penny since it was 51 cents.” Unlike the last problem, with this problem she checked to make sure her answer was correct.

The third pre-instruction problem (see pg. 28) was the most difficult of the three. It asked her to make a judgment as to whether a ball would reach a certain height and then explain her rationale. She made an attempt to do the problem, but it was not a very organized effort. There was not any indication that she knew what the problem was asking her to do. In fact, when we discussed the problem afterwards she said, “I didn’t know what they wanted so I just wrote some stuff down.”

I modeled the graphic organizer on the first pre-instruction problem (see pg. 25) and she filled in the organizers for the other two (see pgs. 27 and 29). It was fairly easy for her to fill in the second graphic organizer (see pg. 27) because she understood the facts of the problem and what the problem was asking her to do. The organizer for the third problem (see pg. 29), however, provided more of a challenge. She had trouble filling in the “What do I want to find?” portion. We re-read the problem and broke down

what parts of the problem were facts that we knew and what parts of the problem were related to what we were trying to find. One thing that I did that really helped her was to draw a sketch of what the problem was referring to. Once she could see the golf balls path and find where the maximum value would be, she was able to more clearly understand what was being asked. We talked about how we broke the problem apart and used that information in the organizer. During that discussion she commented that “this makes more sense once I know what they’re asking me to do.”

After instruction on how to use the organizer, Charlie completed three problems (see pgs. 30, 32 and 34) with the organizer without any support from me. Based on her work on these problems, I feel that we did not completely meet the first objective of the lesson; however, the student is making progress toward critically analyzing the problems and improving her overall performance.

Although she did not answer the first post-instruction question correctly, she did us a much more organized approach. In this case she used a “guess and check” strategy and organized her information in a table. Unfortunately, she did not check that her final answer was correct, even though that is part of one of the areas of the graphic organizer. She did answer the second and third problems correctly utilizing the same “guess and check strategy.” After completing the graphic organizers (see pgs. 31, 33 and 35) Charlie was able to correctly identify all of the facts for each of the three problems. She was also able to clearly state what each of the problems was asking her to find and to identify possible methods for solving each problem. Both of these tasks were challenging for her before the lesson.

The biggest improvement for Charlie has been in meeting the second objective of the lesson. Although the post-instruction problems were as difficult as the pre-instruction problems, she attempted each problem without simply guessing and writing something down. Organizing the information and brainstorming potential ways to solve the problem helped her to overcome the feelings of being overwhelmed by the information in the problem.

After the lesson was completed, Charlie and I talked about her feelings about using the graphic organizer. I have included the questions that I asked her and her answers on page 36. For the most part she felt the organizer was useful and felt that there were certain situations where she would use the organizer. For example, I asked her if she liked using the graphic organizer and she said she did because it made it easier for her to know what she needed to do to solve the problem. I also asked her if this was something that she would use in class. She said she would use it during her homework for the more difficult problems and hoped that she could develop the thinking pattern without having to use the organizer on every problem.

Reflection on Lesson with Charlie

If I had the opportunity to teach this lesson again with Charlie, I would have chosen different pre and post-instruction questions for her. I would have chosen to use at least one multi-part question in each of the two sets of questions. This type of question is more representative of what students see on the ACT and Michigan Merit Exam. It also forces them to decide which pieces of information are needed for each of the parts of the problem. I also would have used a problem that had extra information that wasn't necessary for use in solving the problem. This would have made the

problems more challenging and may have made her see the full benefits of using the organizer.

Another change that I would have made to the lesson is to include more of an explanation piece to the assessment. On one of the pre-instruction questions, I did ask her to explain her rationale, but she was so overwhelmed by the question that she never got to the explanation part of the problem. By incorporating more of the explanation piece into the lesson, I could have more fully utilized the bottom right hand corner of the organizer and done a better job of evaluating the success of using the organizer.

Description of Anna

The second student that I taught was Anna, the 14 year old daughter of a friend. She will be entering the 9th grade in the fall and will be taking Algebra I as her math course. Although Anna reads at grade level, she does not spend much time reading for pleasure. She is a good student and has consistently performed well in school throughout her school career.

It was much more difficult to design pre and post-instruction assessment for Anna as I am not as familiar with her background and ability as I was with Charlie. I selected the KNWSS organizer to use with Anna as it has an emphasis on eliminating information that is not necessary to the problem. This is often a problem for students who are entering an Algebra I course (Standard III) and is something that Anna indicated in her word problem questionnaire that she dislikes about solving word problems (see pg 37).

Analysis of Results with Anna

One major difference between Anna and Charlie is that, although both students have been taught strategies for solving word problems according to their word problem questionnaire, Anna was much more confident in using the strategy she had been taught. When asked if her strategy worked, she said yes. Charlie, on the other hand, said “sometimes.” This difference is also observable in each student’s likeliness to attempt the problems. Although Anna indicated in her word problem questionnaire that she doesn’t like solving word problems (her favorite part is “when I’m done”), she attempted each problem without guessing and didn’t feel pressured to just “write something down” like Charlie did.

In all three of the pre-instruction problems, Anna listed the information that she needed to solve the problem. On the first problem (see pg. 38), she did write down one piece of extraneous information, but then crossed it out when she realized it wasn’t necessary. In problems two and three (see pg. 40 and 42,) she completely ignored the extraneous information.

In problem two, she did miss one piece of information that was important to the solution of the problem. When we talked about the problem, she said that “It wasn’t that I thought it didn’t matter. I missed it completely.”

As I had with Charlie, I explained the graphic organizer to Anna. We went through each of the parts and discussed, in detail, what type of information went into each section. When the discussion was finished, I modeled how to fill in the organizer with the first pre-instruction problem (see pg. 39). After that, Anna filled in the organizers for the second and third problem (see pgs. 41 and 43) with ease. One

aspect of the organizer that she questioned was the need to repeat information in the K section and the N section. I clarified with her that the K section contained all of the facts and that the facts that were not needed would be repeated in the N section.

After the guided participation, Anna answered the post-instruction questions while filling in the graphic organizer (see pgs. 44 through 49). This time she had no problems finding all of the important information and re-listing the information that was not necessary. She used the organizer to do the problems and completed all three problems correctly.

In evaluating Anna's lesson against the objectives, it is clear to me that she was most likely not the best candidate for this study. By evaluating her pre-instruction work, it was obvious that, on her own, she already uses the thinking process that the graphic organizer is designed to encourage. This is most likely due to previous exposure to this type of problem solving strategy. Discussions with her after the lesson revealed that word problem solving strategies have been a focus in her district for the past several years. The secondary objective of engaging students in the problem solving process was also not met with Anna as she is already very comfortable with attempting all word problems, even those she perceives as difficult.

Reflection on Lesson with Anna

Although the lesson was appropriately designed for students with the typical development of a student entering 9th grade and was based on the 9th grade math High School Content Expectations (Standard I), the lesson, as it was presented, was not appropriate for Anna's cognitive development stage. This was due to a lack of

familiarity with this particular student's academic ability. Her organizational skill and cognitive ability are advanced for her age.

Given the opportunity to repeat this lesson with her, I would have used pre and post-instruction problems that would have been significantly more difficult. Based on her work and our discussion during the lesson, these questions were too easy for her as she was able to quickly solve them without even having to write much down. As I mentioned with Charlie, I also would have used some multi-part questions and questions that are similar to the format used on the ACT.

After the lesson was completed, Anna and I also talked about her feelings about using the graphic organizer. I have included the questions that I asked her and her answers on page 50. For the most part she also felt the organizer was useful and that there were certain situations where she would use the organizer.

She did have one suggested change to the organizer. In the KNWSS organizer the student works from left to right. One observation that she made is that it is difficult to determine which information is not needed before knowing what the problem asks for. She suggested that the first step should be to find out what the problem is asking us to find. Then she suggested finding the known information, then the extraneous information and finally, the strategy and solution. Effectively, the organizer would then be a WKNSS.

Additional Thoughts

Ideally, I would have used this lesson with an entire classroom full of students and would have had many students to compare to gauge the effectiveness of the lesson. I also would have had more time to conduct multiple lessons with the students

on using graphic organizers and the students would have had more consistent practice using them. It is clear that using organizational devices improve student understanding and achievement. According to Joseph Fisher, et al. in *Improving the Reading Comprehension of At-Risk Adolescents*, “The organizing routines help students to understand the underlying structures to which all of the pieces of information they are learning are related. If they understand these structures and relationships, they are more likely to focus on the most important information as they read, and they are more likely to remember it.” (Fisher, et al., 2002, p.358.) I plan on incorporating graphic organizers and more reading of math text into my classroom as a focus area this coming school year.

Because these lessons were taught to individual students, it is difficult to address the literacy learning community of Standard IV. However, I definitely plan on using this type of lesson in my classroom this fall as part of group or partner activities. Both of the students in my case study suggested that they felt the graphic organizers would be useful as the centerpiece of a small group discussion. It is at that point I would incorporate Standard IV into the lesson.

References

- Ehren, B. J. (2005). Looking for evidence-based practice in reading comprehension instruction. *Topics in Language Disorders*, 25, 310-321.
- Fisher, J. B., Schumaker, J. B., & Deshler, D. D. (2002). Improving the reading comprehension of at-risk adolescents. In C. C. Block & M. Pressley (Eds.), *Comprehension instruction: Research-based best practices* (pp. 351-364). New York: Guilford.

K-N-W-S-S Worksheet

K What facts do I KNOW from the information in the problem?	N Which information do I NOT need?	W WHAT does the problem ask me to find?	S What STRATEGY/operation/tools will I use to solve the problem?

S SOLVE the problem here. Does my answer make sense?

**Appendix B – Diamond
Organizer**

What do I know?

Brainstorm ways to solve.

What do I
want to find?

Try it here. Does my answer make sense?

Things I need to include in my explanation.

Appendix C – Lesson Plan

Lesson Title/Topic

Improving math word problem performance by improving reading comprehension through use of graphic organizers.

Goal/Purpose

The goal of this lesson is to teach students how to critically analyze math word problems to improve their comprehension and their overall performance on this type of problem.

Student Outcomes

- The student will be able to organize the important information from a word problem in a graphic organizer.
- The student will be able to use the graphic organizer to help decide how to solve the problem.

Procedures/Plan of Action

Launch: I will start the lesson by having the students talk with me about word problems, discussing what they like and don't like about that type of problem. They will also fill out a questionnaire regarding how they have approached word problems in the past. I will have them solve two to three word problems using their usual approach. We will then talk about their questionnaire results, how they approached solving the word problems and about other possible strategies for solving word problems. We will also talk about graphic organizers, the purpose behind them and any experience they have had with them.

Explore: During the explore portion of the lesson I will introduce the graphic organizer that we will be using. I will describe the parts of the organizer and what the purpose of each part is. During this portion of the lesson, I will model how to use the graphic organizer by filling the organizer in using one of the problems that they solved during the launch portion. I will then have students fill in the organizer for the other problems used during the launch, providing support when necessary. Finally, I will have students complete two to three problems on their own without support.

Summarize: During the summarize portion of the lesson, I will review with the students the process of using the graphic organizer. We will also discuss how they felt about using the organizer and if it is something that they feel is helpful for solving this type of problem.

Appendix C - continued

Plan for Assessing Student Learning

The main form of assessment will be a comparison of student work from before the lesson to the completed graphic organizers that are generated after the lesson. The assessment of student learning will also happen through the discussion that is generated about both the problems that are being solved and the process of using the graphic organizer.

Standards/Benchmarks

Algebra I Standards:

A1.2.1
A2.4.1
A2.4.2
A2.4.3

Algebra II Standards:

A1.1.1
A2.4.1
A2.4.2
A2.4.3

Learning Theory

This lesson uses graphic organizers to help students solve math word problems by improving their reading comprehension. Reading comprehension is improved by helping students organize the information from the problem into visual categories. Categorizing the information helps students to think through the problem solving process and then use the information to correctly solve the problem.

Needed Materials and Spatial Arrangements

Materials:

- Math word problems of comparable difficulty for use as pre and post assessment.
- Graphic organizers

Spatial Arrangements:

- None

Appendix D – Word Problem Questionnaire

Word Problem Questionnaire

1. When you are faced with a word problem, what is normally your approach to solving it?
2. What do you like about solving word problems?
3. What do you dislike about solving word problems?
4. Have you been taught any specific strategies for solving word problems? If so, what were they and have they been successful?

Appendix E – Pre-Instruction Problems

Pre-Instruction Problems for Charlie

1. A man is 27 years older than his son and 10 years from now, he will be twice as old as his son. How old is each now?
2. Steve has \$20.51 of change. he has twice as many quarters as pennies and 20 times as many half dollars as quarters. How many of each type does he have?
3. The equation $0 = -16t^2 + 80t + 20$ gives the time t in seconds when a golf ball is at a height of 0 feet. Will the height of the ball reach 130 feet? Explain. Solve the given quadratic equation.

Pre-Instruction Problems for Anna

1. A middle school has 1200 students. Of these, 25% are in the eighth grade and 32% are in the ninth grade. Yesterday, 95% of all eighth graders were present. How many eighth-grade students were absent yesterday?
2. 331 students and 10 parents went on a field trip. Six buses were filled with the same number of students on each bus and 7 students traveled in cars. How many students were in each bus?
3. There are 150 people born in the world every minute. 90 of them are boys and 60 of them are girls. How many people are born every hour? Every day? Every year?

Appendix F – Post Instruction Problems

Post-Instruction Problems for Charlie

1. Jason is 4 times older than Bob at present. 8 years ago Jason was 12 times older. How old are Jason & Bob?
2. Jed has a stamp collection. He has 2 more 25 cent stamps than he has 32 cent stamps, and he has twice as many 50 cent stamps as he has 25 cent stamps. Altogether he has \$10.35 worth of stamps. How many of each type: 25, 32, and 50 cent stamps does he have?
3. An architect designs a rectangular room with an area of 400 ft^2 . The length is to be 8 ft longer than the width. Find the dimensions of the room. Round your answers to the nearest tenth of a foot.

Post-Instruction Problems for Anna

1. Sam loves basketball. He makes 35% of his three point shots and 70% of his free throws. If he takes 30 free throw shots, how many did he make?
2. John won 40 super bouncy balls playing a game at the school carnival. 14 of them are green, 10 are blue, and 16 are red. He gave each of his friends 2 balls and had 8 balls remaining. How many friends did he give balls to?
3. Ryan has \$24 to spend on seven pencils. After buying them he has \$10 left. How much did each pencil cost?

Appendix G – Work Samples for Charlie

Charlie

Word Problem Questionnaire

1. When you are faced with a word problem, what is normally your approach to solving it?

Read it and if it's too hard
skip it.

2. What do you like about solving word problems?

They are mostly real-life situations.

3. What do you dislike about solving word problems?

They don't spell out the problem.
There is extra information.
You don't always know what to do
with the information.

4. Have you been taught any specific strategies for solving word problems? If so, what were they and have they been successful?

To try & pick out the important
information.
It works sometimes.

Name: charlie

Pre-Instruction Problems

1. A man is 27 years older than his son and 10 years from now, he will be twice as old as his son. How old is each now?

~~37 10 yrs from now~~

$$\underline{40 - 27 = 13}$$

$$\begin{array}{r} 50 \\ -27 \\ \hline 23 \end{array} \quad \begin{array}{r} 60 \\ -27 \\ \hline 33 \end{array} \quad \begin{array}{r} 60 \\ -27 \\ \hline 33 \end{array} \quad \begin{array}{r} 1 \\ 27 \\ \cdot 2 \\ \hline 54 \end{array}$$

$$54 \div 27$$

"I guessed."

"I picked numbers until I got tired of it."

What do I know?

- man is 27 years older than son.
- In 10 years the man will be twice as old as his son.

Brainstorm ways to solve.

- Write 2 equations and solve
- Graph
- Table
- Guess and check

What do I want to find?

- How old are the man and his son now?

Try it here. Does my answer make sense?

Write 2 equations + solve

d = dad

S = son

d = S + 27 d + 10 = 2(S + 10)

Solve w/ substitution

$$S + 27 + 10 = 2S + 20$$

$$S + 37 = 2S + 20$$

$$\begin{array}{r} S + 37 = 2S + 20 \\ -20 \quad \quad -20 \\ \hline S + 17 = 2S \end{array}$$

$$\begin{array}{r} S + 17 = 2S \\ -S \quad \quad -S \\ \hline 17 = S \end{array}$$

$$d = 17 + 27 = 44$$

Things I need to include in my explanation.

- Know → facts of problem
- what's being found
- what possible methods
- Used 2 equations because it was the quickest way
- Explain steps
- makes sense because son is younger than dad

2. Steve has \$20.51 of change. he has twice as many quarters as pennies and 20 times as many half dollars as quarters. How many of each type does he have?

$$1 \text{ penny} \cdot 2 = 2 \text{ quarters}$$

$$2 \cdot 20 = 40$$

50¢

20.51

1¢

20.50

1 penny

$$2 \text{ quarters} = 50¢$$

$$40 \text{ half dollars} = 20.00$$

2 quarters

40 half ~~50~~ dollars

" I started with one penny
 since it was 51¢ "

What do I know?

- Steve has \$20.51
- Twice as many quarters as pennies
- 20 times as many half dollars as quarters

Brainstorm ways to solve.

- 3 equations + solve.
- guess + check with table.

What do I want to find?

• How many pennies, quarters + half dollars does he have?

Try it here. Does my answer make sense?

Table
 p = pennies
 q = quarters
 h = half dollars
 t = total amount of money

p	q	h	t
1	2	40	\$20.51

Things I need to include in my explanation.

- table
- Started with pennies because the total was \$20.51.
- Steve has 1 penny, 2 quarters + 40 half dollars.
- I started with 1 penny and that guess worked.

3. The equation $0 = -16t^2 + 80t + 20$ gives the time t in seconds when a golf ball is at a height of 0 feet. Will the height of the ball reach 130 feet? Explain. Solve the given quadratic equation.

$$130 = 16t^2 + 80t + 20$$

$$110 = 16t^2 + 80t$$

$$110 = 16t + 80$$

$$\frac{30}{16} = \frac{16t}{16}$$

no it won't
the equation doesn't work
for 130.

"I didn't know what they wanted
& so I just wrote some stuff
down."

What do I know?

- $0 = -16t^2 + 80t + 20$ is the equation for what time in seconds a golf ball is at the height of zero feet.
- $t = \text{time in seconds}$

Brainstorm ways to solve.

- Graph
- table
- discriminant

What do I want to find?

- If the height of the ball will reach 130 feet.
- Solve the equation

Try it here. Does my answer make sense?

Graph
 using calculator
 use table to find maximum.
 use table to find zeroes

Things I need to include in my explanation.

- I figured out what I knew + what I needed to find.
- I thought of ways to solve the problem + chose a graph because it was the easiest.

"This makes more sense once I know what they're asking me to do."

Name: _____

Post-Instruction Problems

1. Jason is 4 times older than Bob at present. 8 years ago Jason was 12 times older. How old are Jason & Bob?

Guess & Check

now	
Jason	Bob
16	4
24	6
32	8
40	10

8yrs ago	
Jason	Bob
24	2
32	18

Jason is 32 now & Bob is 8.

What do I know?

- Jason is 4 times older than Bob now.
- 8 yrs ago Jason was 12 times older.

Brainstorm ways to solve.

- Write two equations + solve
- Graph
- table + guess + check

What do I want to find?

- How old are Jason + Bob?

Try it here. Does my answer make sense?

Table: now

J = Jason ; B = Bob

J	B	J - 8	B - 8
16	4	24	2
24	6	32	18
32	8		
40	10		

8 yrs ago

Things I need to include in my explanation.

- What I knew + what I needed to find.
- How I did it.
- Jason = ~~24~~ 32
- Bob = ~~8~~ 8

2. Jed has a stamp collection. He has 2 more 25 cent stamps than he has 32 cent stamps, and he has twice as many 50 cent stamps as he has 25 cent stamps. Altogether he has \$10.35 worth of stamps. How many of each type: 25, 32, and 50 cent stamps does he have?

Guess + Check

w/ Table

25¢	32¢	50¢	Total
6	4	12	8.78
9	7	18	13.49
8	6	16	11.92
7	5	14	10.35

Jed has 7 25¢ stamps, 5 32¢ stamps,
+ 14 50¢ stamps.

What do I know?

- Jed has 2 more 25¢ stamps than 32¢ stamps.
- He has twice as many 50¢ stamps as 25¢.
- He has \$10.35 worth of stamps.

Brainstorm ways to solve.

- Table
- Guess & Check
- equation

What do I want to find?

• How many 25¢, 32¢ & 50¢ stamps does he have?

Try it here. Does my answer make sense?

Table

25¢	32¢	50¢	total
6	4	12	\$8.78
9	7	18	\$13.49
8	6	16	\$11.92
7	5	14	\$10.35

Things I need to include in my explanation.

- What I knew & what I needed to find out.
- I picked guess & check because it is easier.
- Jed has 7 25¢ stamps; 5 32¢ stamps; + 14 50¢ stamps.

3. An architect designs a rectangular room with an area of 400 ft^2 . The length is to be 8 ft longer than the width. Find the dimensions of the room. Round your answers to the nearest tenth of a foot.

Guess + Check

length	width	Area
18	10	180
28	20	560
24	16	384
24.5	16.5	404.16
24.4	16.4	400.16

24.4 ft. by 16.4 ft.

What do I know?

- room has area of 400 ft.²
- length is 8 ft. longer than width

Brainstorm ways to solve.

- Equation
- Table
- Guess + Check

What do I want to find?

- dimensions of the room to the nearest 10th of a foot.

Try it here. Does my answer make sense?

Guess + check

$$A = bh$$

length	width	Area
18	10	180
28	20	560
24.4	16.4	400.16
24.5	16.5	404.25
24	16	384

Things I need to include in my explanation.

- What I knew + what I needed to find
- I did Guess + Check
- Room is 24.4 ft. by 16.4 ft.

Post-Lesson Discussion with Charlie

After the lesson was completed, I asked Charlie the following questions regarding the lesson.

1. Did you like the graphic organizer? Why or why not?

I liked the graphic organizer because it made it easier to see what you needed to do to solve the problem. Brainstorming possible methods for solving the problem helped me to not feel so intimidated and overwhelmed by how to do it.

2. Would you use this method in class? Why or why not?

I wouldn't use this method on every word problem on my homework because it takes too long to fill out and some problems are easy enough to do without using it. I would use it on problems that I think are hard or when I don't know how to get started which were problems that I would've skipped before. After using the organizer some I would probably be able to use the thinking pattern without having to fill it in.

3. Do you think it would be helpful to work in groups or pairs when filling out the graphic organizer? Why or why not?

I think it would be helpful to do these with a group or a partner. When you work with someone else you have to explain what you are doing which makes it easier to fill in. I also think it would be easier to come up with the brainstorm list of ways to solve it if you have other people thinking about it with you.

4. Are there any changes to the graphic organizer that you would suggest?

I would take out the part where it lists what I need to include in my explanation of how to do the problem. I didn't think that part was that helpful.

Appendix H – Work Samples for Anna

Word Problem Questionnaire

1. When you are faced with a word problem, what is normally your approach to solving it? *read it and find the useable info*
2. What do you like about solving word problems?
when im done
3. What do you dislike about solving word problems?
The misleading info
4. Have you been taught any specific strategies for solving word problems? If so, what were they and have they been successful? *yes, read and highlight the info you want, yes it works*

Name: _____

Pre-Instruction Problems

1. A middle school has 1200 students. Of these, 25% are in the eighth grade and 32% are in the ninth grade. Yesterday, 95% of all eighth graders were present. How many eighth-grade students were absent yesterday?

1200 students ~~95%~~
300 = 25% 8th grade 5% of 8th grade
~~= 22% 8th grade~~ 300 = 15

15 8th graders Absent

K-N-W-S-S Worksheet

K What facts do I KNOW from the information in the problem?	N Which information do I NOT need?	W WHAT does the problem ask me to find?	S What STRATEGY/operation/tools will I use to solve the problem?
<ul style="list-style-type: none"> • 1200 total students • 25% 8th • 32% 9th • 95% of 8th graders were present yesterday 	<ul style="list-style-type: none"> • 32% were 9th graders 	<p>How many 8th graders were absent yesterday?</p>	<ul style="list-style-type: none"> • Percentages • multiply + divide • ratios / proportions
S			
SOLVE the problem here. Does my answer make sense?			
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>1200 students total 25% are 8th graders 5% were absent</p> </div> <div style="width: 45%;"> <p>$1200 \times 0.25 = 300 \rightarrow$ 8th graders $300 \times 0.05 = 15 \rightarrow$ absent 8th graders</p> <p style="text-align: center; margin-top: 20px;">15 8th graders are absent</p> </div> </div>			

2. 331 students and 10 parents went on a field trip. Six buses were filled with the same number of students on each bus and 7 students traveled in cars. How many students were in each bus?

331 students

$$331 \div 6 \approx 55 \text{ student in every bus}$$

Six buses

No remainder

"I wasn't that I thought it didn't matter. I missed it completely."

K-N-W-S-S Worksheet

K What facts do I KNOW from the information in the problem?	N Which information do I NOT need?	W WHAT does the problem ask me to find?	S What STRATEGY/operation/tools will I use to solve the problem?
<p>331 students 10 parents 6 buses 7 by car</p>	<p>Parents 7 by car</p>	<p>how many 5 students in each bus?</p>	<p>0 - and $\frac{0}{0}$</p>
S			
SOLVE the problem here. Does my answer make sense?			
<p style="font-size: 1.5em; margin-left: 50px;">331 - 7 = 324 ÷ 6 = 54</p>			


3. There are 150 people born in the world every minute. 90 of them are boys and 60 of them are girls. How many people are born every hour? Every day? Every year?

$$150 \text{ - minute} \times 60 = 9,000$$

$$150 \text{ - minute} \times 60^{24} \times 24 = 216,000$$

$$150 \text{ - minute} \times 60^{365} \times 24 = 78,624,000$$

K-N-W-S-S Worksheet

K What facts do I KNOW from the information in the problem?	N Which information do I NOT need?	W WHAT does the problem ask me to find?	S What STRATEGY/operation/tools will I use to solve the problem?
<p>150 - every min 90 boys 60 girls</p> 		<p>Total barn hour day and year</p>	<p>X</p>
S			
SOLVE the problem here. Does my answer make sense?			
$150 \times 60 = 9000$ $150 \times 60 \times 24 = 216,000$ $150 \times 60 \times 24 \times 364 = 78,624,000$			

Name: _____

Post-Instruction Problems

1. Sam loves basketball. He makes 35% of his three point shots and 70% of his free throws. If he takes 30 free throw shots, how many did he make?

$$70\% = 70$$

$$30 \times 70 = 21$$

K-N-W-S-S Worksheet




K What facts do I KNOW from the information in the problem?	N Which information do I NOT need?	W WHAT does the problem ask me to find?	S What STRATEGY/operation/tools will I use to solve the problem?
<p>35% 3 point 70% free throws 30 ^{shots} shot</p>	<p>35% 3 point</p>	<p>how many free throw did he make</p>	<p>$\% - \frac{\circ}{\circ}$</p>
S SOLVE the problem here. Does my answer make sense?			
<p>$70\% = 70$ $30 \times 70 = 21$</p>			<p>Yes</p>

2. John won 40 super bouncy balls playing a game at the school carnival. 14 of them are green, 10 are blue, and 16 are red. He gave each of his friends 2 balls and had 8 balls remaining. How many friends did he give balls to?

$$40 - 8 = 32$$

$$32 \div 2 = 16$$

K-N-W-S-S Worksheet

K What facts do I KNOW from the information in the problem?	N Which information do I NOT need?	W WHAT does the problem ask me to find?	S What STRATEGY/operation/tools will I use to solve the problem?
<p>40 balls 14 green 10 blue 16 red 2 balls each</p>	<p>Color of balls</p>	<p>how many buds he has</p>	<p>\div and  -</p>
S SOLVE the problem here. Does my answer make sense?			
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;"> <p>16</p> <p></p> </div> <div style="width: 40%; text-align: center;"> <p>$40 - 2 = 32$</p> <p>$32 \div 2 = 16$</p> <p>32</p> </div> <div style="width: 20%; text-align: center;"> <p>Yes</p> <p></p> </div> </div>			

3. Ryan has \$24 to spend on seven pencils. After buying them he has \$10 left. How much did each pencil cost?

\$24
7 pencils
\$10 Left

$$24 - 10 = 14$$

$$14 \div 2 = 7$$

each pencil is \$2

K-N-W-S-S Worksheet

K What facts do I KNOW from the information in the problem?	N Which information do I NOT need?	W WHAT does the problem ask me to find?	S What STRATEGY/operation/tools will I use to solve the problem?
<p>24 dollars 7 pencils \$10 Left</p>	<p>All needed</p>	<p>amount of each Pencil</p>	<p>— and ÷</p>
S			
SOLVE the problem here. Does my answer make sense?			
<p>$24 - 10 = 14$</p> <p>$14 \div 2 = 7$</p> <p style="font-size: 2em; border: 1px solid black; display: inline-block; padding: 5px;">2</p>		<p>yes if they were Crazy / equie in any way</p>	

Post-Lesson Discussion with Anna

After the lesson was completed, I asked Charlie the following questions regarding the lesson.

5. Did you like the graphic organizer? Why or why not?

I liked the graphic organizer because I could use it to spread the information out into different areas and look at it better.

6. Would you use this method in class? Why or why not?

I may use it on the really hard problems, but I already tend to organize things the same way without it.

7. Do you think it would be helpful to work in groups or pairs when filling out the graphic organizer? Why or why not?

I think it would be helpful to do these with a group or a partner. It would be a really good way to organize the information from everyone in the group instead of having different stuff written on a bunch of different papers.

8. Are there any changes to the graphic organizer that you would suggest?

I would put the W first because you need to know what the problem is asking for before you can decide what information you don't need.